...Noel Lit...

...ers, 12/6 net. [No. 34.

...commence in JULY. Title and Index

...Binding, 4/- net; or the Volume

...four numbers, for 7/6 net, post free.

British Journal of Surgery

UNDER THE DIRECTION OF THE FOLLOWING EDITORIAL COMMITTEE:

...K.C.M.G., C.B. (Leeds), *Chairman.*

Sir WM. ARBUTHNOT LANE, Bt., C.B. (London)
Sir ALEXANDER MacCORMICK (Sydney)
Sir GEO. H. MAKINS, G.C.M.G., C.B., LL.D. (London)
SIDNEY A. MOFFAT, D.S.O. (Capetown)
RUTHERFORD MORISON (Newcastle-on-Tyne)
Sir THOMAS MYLES, C.B. (Dublin)
R. H. PARRY (Glasgow)
Sir D'ARCY POWER, K.B.E. (London)
SYDNEY W. F. RICHARDSON (Capetown)
JAMES SHERREN, C.B.E. (London)
GRAHAM S. SIMPSON (Sheffield)
THOMAS SINCLAIR, C.B. (Belfast)
Sir HAROLD J. STILES, K.B.E. (Edinburgh)
EDWARD H. TAYLOR (Dublin)
Sir J. LYNN-THOMAS, K.B.E., C.B., C.M.G. (Cardiff)
HENRY ALEXIS THOMSON, C.M.G. (Edinburgh)
Sir WILLIAM THORBURN, K.B.E., C.B., C.M.G. (Manchester)
GREY TURNER (Newcastle-on-Tyne)
GEORGE E. WAUGH (London)
W. J. de COURCY WHEELER (Dublin)

..., *Editorial Secretary.*

1921

...WRIGHT & SONS LTD.

...SIMPKIN, MARSHALL, HAMILTON, KENT & CO. LTD

...MACMILLAN CO. OF CANADA LTD.

...SPINK, & CO. BOMBAY: W. THACKER & CO

...NEW ZEALAND: WHITCOMBE & TOMBS LTD.

...WOOD & CO., NEW YORK, *Sole Agents.*

256
259
272
281
287
290
293
295
297
298
302
304
306
308
310
311
314

Electronic Tons

Ltd.

RECONSTRUCTION OF THE COMMON BILE-DUCT.

By A. J. WALTON, London.

There are certain cases where the common bile-duct is obstructed or destroyed in which cholecystenterostomy is unwise or impossible. These cases present some of the greatest difficulties in surgery, and, with the increase of operative treatment upon the gall-bladder and ducts, it is found that they are not so uncommon as was at one time believed. They may be grouped under the following headings: (1) Accidental injury and removal of a portion of the common duct in performing the operation of cholecystectomy; (2) Injury of the hepatic or common ducts owing to the absence of a cystic duct; (3) Certain cases of early chronic pancreatitis; (4) Certain cases of advanced chronic pancreatitis; (5) Combined carcinoma of the gall-bladder and common duct; (6) Some cases of carcinoma of the head of the pancreas; (7) Obstruction of the common bile-duct from scar tissue, either within or without the lumen of the duct.

These groups will not all present the same problems; for in the first three the common bile-duct is either of normal size or is collapsed, while in the last four it may be considerably dilated.

1. **Accidental Injury of the Common Duct during Operation of Cholecystectomy.**—This is much less common than was at one time believed. Fowler[4] quotes Kehr as having had sixteen such injuries during one thousand cholecystectomies, and Jacobson has shown that injuries to the common and hepatic ducts are usually the result of operative accidents. Probably injury is much more common than one would be led to believe from a study of the literature, for many surgeons are shy of reporting their own errors. The conditions which may place the duct in danger are, however, so many that it is probable that there are very few surgeons frequently performing cholecystectomy who have not at some time or other injured the duct. In the early days of the operation, when it was customary to commence removal of the gall-bladder from the fundus, it was very easy, if there were many adhesions around Hartmann's pouch, to pull up a loop which was formed of the common and hepatic ducts, and to divide this loop right across in the belief that it was a cystic duct. Before it was the custom to examine the common bile-duct as a routine procedure, it was probably not infrequently ligatured before the cystic duct was divided, and thus the accident was entirely overlooked. The case which first directed my attention to this accident was of this nature. The patient was returned to bed with no indication that there was any untoward condition; later, the hepatic duct gave way and a fatal peritonitis was produced. Even with the more general introduction of removal of the gall-bladder from the cystic duct end, the presence of firm adhesions around the neck of the gall-bladder may lead to a similar complication. In the second case in my series the accident was of this nature, but happily the presence of two openings was discerned in the wound and an immediate end-to-end suture was performed with satisfactory results. This led me to make the invariable rule that the cystic duct was never to be divided until all three ducts, namely, the hepatic, cystic, and common, were clearly exposed in the operative field. In spite of this precaution, accidents may still arise which are more prone to occur owing to some abnormality of the cystic artery. Both Mayo[17] and Eliot[3] have laid stress upon the danger of clamping the duct in attempting to pick up the retracted proximal end of a divided cystic artery. The danger is much increased if there have been many surrounding inflammatory changes from a chronic cholecystitis, and especially is this so if there is a fistula between the gall-bladder and the intestine, for in this condition the anatomical relationships may be so distorted that the common duct may be injured before its position is realized. Owing to the fact

that the gall-bladder has been removed, a cholecystenterostomy is of course impossible. As a general rule, however, attempts to explore the common duct will lead to an early recognition of the condition, and an end-to-end anastomosis is then usually performed. Even with this operation the results may not be entirely satisfactory, as there is a certain tendency for stenosis to occur at the site of the union. If the damage be overlooked, a permanent fistula will result. By the time the second operation is undertaken, the lower end of the common duct is often so contracted and collapsed that it cannot be found, and an end-to-end suture then becomes impossible.

2. **Injury of the Common and Hepatic Ducts owing to an Absence of the Cystic Duct.**—It is of interest to note that the possibility of this condition has been denied. Rolleston,[22] in commenting on the case reported by Cucknell, states that this was probably an example of absence of the gall-bladder with dilatation and pouching of the upper end of the common duct. There has, however, occurred in my series a case in which the patient had a normal gall-bladder situated in the usual position and containing gall-stones. When the gall-bladder was removed, it was realized that there were left behind two divided hepatic ducts and a divided common duct. These were sutured together, and an after dissection of the specimen showed the complete absence of any cystic duct (*vide Fig.* 159). The two hepatic ducts entered the gall-bladder on one side, and the common duct emerged from it on the other. In such a condition—which must be very rare—it would seem impossible to avoid division of the attached ducts.

3. **Certain Cases of Early Chronic Pancreatitis.**—It occasionally happens, as in my first case of reconstruction, that a patient will present the symptoms of colic; that at operation no stones will be found; that the gall-bladder and common duct will not be dilated, but the pancreas may be hard and nodular, and a probe will fail to enter the duodenum. Under such conditions a faulty diagnosis is very likely to be made, and the duct regarded as unobstructed. If a cholecystenterostomy be not performed, it is probable that the increasing obstruction will be sufficient to cause the opening in the common duct to break down, and to lead to the formation of a permanent biliary fistula. At a second operation the lower end of the duct may be so altered that it cannot be isolated, and the upper end will be found open and discharging bile. A cholecystenterostomy may be impossible, either because the gall-bladder had been removed at the first operation, or because it has become too shrunken and contracted.

4. **Certain Cases of Advanced Chronic Pancreatitis.**—It may happen that a patient will present definite symptoms of common-bile-duct obstruction, but it is uncertain whether the obstruction is due to gall-stones or to the presence of chronic pancreatitis. At operation the gall-bladder is found distended. It is aspirated as a preliminary to performing a cholecystenterostomy. Instead of the thick tenacious bile which is usually found under these conditions, a thin white mucoid fluid escapes. This at once leads to the suspicion that the cystic duct is obstructed, and that the distention of the gall-bladder is due to mucus and not to bile. In order to settle the diagnosis an incision may be made into the common bile-duct, when the escape of a similar fluid clearly determines that the absence of bile is due to a failure on the part of the liver, and the ducts are distended with a so-called white bile. The surgeon is now in a difficulty. If the common bile-duct be sutured and a cholecystenterostomy performed, it is very probable that the wound in the common duct will give way and that a permanent fistula will be formed, so that it will appear safer to attempt to perform a union between the duodenum and the opening in the common bile-duct.

5. **Combined Carcinoma of the Gall-bladder and Ducts.**—It will sometimes happen that there is a carcinoma of some portion of the common duct together with gall-stones and a carcinoma of the gall-bladder. Under such conditions it may be impossible, owing to the extent of the disease in the gall-bladder, to perform a cholecystenterostomy. Moreover, if one growth be situated at the junction of the cystic and common ducts there will be no regurgitation of bile into the gall-bladder, and hence an operation of this sort would be of no benefit. If the growth be relatively high up, it may be a very difficult matter to perform a direct lateral anastomosis between the duct and the duodenum. In those

cases in which the growth is so localized that the surgeon is able to remove the diseased portion of the duct and the gall-bladder, the duct will be left completely divided, and there may often be a very considerable gap, so that an end-to-end suture becomes difficult or impossible. The same is true with an uncomplicated carcinoma of the duct, if it be situated so high that during its removal the cystic duct is separated from its junction with the common hepatic duct.

6. **Some Cases of Carcinoma of the Head of the Pancreas**.—The conditions here will be identical with those occurring with a chronic pancreatitis; but the cases are even less satisfactory, for even if a new duct be made the carcinoma will have to be left *in situ*, where it will continue to grow. Mayo[17] has laid stress on the unsatisfactory results of this operation. Of four cases, two died soon after the operation and the other two lived for less than eighteen months.

7. **Obstruction of the Common Bile-duct from Scar Tissue, either within or without the Lumen of the Duct.**—This condition is rare. Occasionally a stone impacted in the duct may ulcerate into the walls, and at the site of ulceration a fibrous stricture may develop. This is more prone to happen at the junction of the three ducts, for here the duct is less likely to dilate and overcome the stricture. Under these circumstances the gall-bladder is less likely to be distended, so that a cholecystenterostomy becomes impossible or useless, and some form of duct anastomosis or reconstruction will be necessary.

The operations which have been undertaken in an attempt to treat the foregoing conditions are many, and may be grouped as follows:—

1. **Direct Suture.**—This is the operation which is most commonly performed. In Jacobson's series there were 21 cases of end-to-end anastomosis combined with drainage of the hepatic duct, and 2 cases of end-to-end anastomosis without drainage of the duct. Eliot was able to collect 16 cases of primary suture for injuries and 7 of end-to-end suture after resection of the stricture. Two methods of operating have been carried out. In the one the ducts are directly united, and in the other they are joined around a T-shaped rubber tube. It is probable that either of these operations will only be feasible immediately after the duct is divided; that is, where obstruction has been removed or an accidental division has been recognized immediately. If a persistent biliary fistula be present, the lower end will generally be so contracted and shrunken that it will be impossible to find. It is, moreover, a little doubtful whether the operation of end-to-end suture is as ideal as would at first sight appear. If no tube is used, there is the possibility that the junction may constrict. Of my own two cases (Nos. 2 and 3), one remained perfectly well, but the other has since developed attacks of pain and jaundice. In Eliot's[3] collected 23 cases there were 4 failures with recurrence of jaundice. Suture around a T tube would appear to be unsound theoretically, for it will only be possible for the tube to be removed from the duct by a process of ulceration or tearing of the junction, and hence an irregular opening will be left which is liable to constrict.

2. **Lateral Choledochenterostomy.**—The formation of an anastomosis between the duct and the duodenum will generally only be possible when the obstruction is low down and when no biliary fistula is present; that is, when the common duct is considerably dilated. Under such conditions the operation has not uncommonly been employed, although there has often been considerable difficulty in obtaining accurate apposition of the openings. For this reason Horz[11] advocated that the anastomosis should be performed around a rubber tube, the lower end of which is brought out through a second opening in the duodenum and drained externally, the tube being removed on the eighth day. Sasse[23] obtained very satisfactory results with choledochenterostomy, and advocated that the operation should be more frequently performed, and even undertaken in cases of obstruction by a calculus, thus allowing freer drainage of the duct. My own experience of this operation has not been satisfactory. The only case in which I performed it (No. 4) was one of chronic pancreatitis together with stones, and, although there was no leakage of bile, the patient collapsed and died four days after the operation. In order to make the anastomosis, it is necessary to angulate the duct and duodenum so as to bring them

into apposition, and the operation appears to cause undue stress upon the line of junction.

3. **Re-formation of an Absent Common Duct.**—When a portion of the common duct is entirely absent, an attempt must be made to form a new path along which the bile can enter the intestine. Of the many steps that have been taken to produce this result, some appear to-day to be fantastic, and must be simply regarded as interesting steps in the development of modern technique. They may be considered as follows :—

i. *Hepatico-enterostomy.*—Here a small portion of the liver was excised so as to leave a raw area, in which the bile-ducts were opened. An incision was then made into a loop of the jejunum, and the edges of the incision were sutured to the margin of the liver. This operation failed because the bleeding from the edge of the liver was difficult to control, it was difficult or impossible to suture the intestine to the liver, and there was danger of infection spreading from the intestine to the intrahepatic ducts.

ii. *Anastomosis between the Fistula and Duodenum.*—Operations of this sort were doomed to failure; for not only was it extremely difficult to perform an anastomosis between the edge of the fistula and the intestine, but a fæcal fistula was likely to arise, or the walls were almost certain to fibrose and contract so that the path became contracted.

iii. *Direct Implantation of the End of the Divided Duct into the Duodenum.*—This operation, which was apparently first performed by W. J. Mayo,[16] is the one most commonly adopted, and the one which would at first sight appear to be the most satisfactory. Several cases have now been reported. Fowler[4] says that he has had several where the operation was performed after resection of cancer of the duct, and once after partial gastrectomy for cancer of the pylorus: the cases for carcinoma were on the whole disappointing. He reports another case in which the operation was performed after an accident to the duct, the hepatic duct being implanted in the duodenum around a tube, with very satisfactory results. One of Mayo's[17] cases is now reported well ten years after the operation. Similar operations have been performed by Packard,[19] Harrington,[10] and White and Lund. In Packard's case an ulcer was found occluding the duct at the papilla of Vater. The common duct was isolated and cut off from the duodenum. It was directly anastomosed to the duodenum, the walls of which were folded over the duct in order that the latter might run an oblique course and hence have a valvular opening. Whenever the duct is sufficiently long to allow of it being drawn down, and for the gut wall to be folded over it so as to make a valve, this operation is unquestionably the one of choice. Unfortunately it not uncommonly happens that it is too short for this purpose. So large a portion of it may be destroyed that it cannot even be brought into contact with the duodenum, and much less is there sufficient to allow of a valvular opening. The formation of a valvular opening would seem to be essential; otherwise there is grave danger of infection spreading from the duodenum and leading to suppurative cholangitis. In certain cases the difficulty may be overcome by implanting it into a loop of the jejunum instead of into the duodenum. Such a case was reported by Jackson,[12] where an obstruction of the common duct together with a biliary fistula resulted from an operation for carcinoma of the stomach. The upper portion of the duct was dissected out and divided; the cut end would not reach the duodenum, and hence a loop of small intestine was brought up to it and sutured to the liver to relieve tension. The bile-duct was inserted obliquely into it, the anastomosis being made around a rubber tube. The small intestine should always be chosen in preference to the colon, for, as Weidemann[27] has shown, a junction between the gall-bladder and the colon in dogs is followed by a fatal ascending infection. It not uncommonly happens that even this step is not feasible, for it may not be possible to bring a loop of small intestine sufficiently high up without causing kinking of the large or small intestine.

iv. *The Use of Autogenous Grafts.*—Several attempts have been made to bridge the gap in the common bile-duct by the use of some other tissue. Giordano and Stropeni[8] first made use of a portion of vein, and similar experiments were carried out with success in dogs by Giacinto and Luigi.[6] In these cases, however, the vein was simply used to bridge the gap between the two ends of the duct, and thus the difficulty of forming a new

valvular opening was not encountered. Molineus[18] also suggested the use of the appendix, but did not perform the operation in the living. Lewis and Davis[14] first advocated the use of transplanted fascia from the abdominal wall, and successfully used this in experiments on dogs. Ginsburg and Speese[7] have since quoted a case in which this method was used in a patient; but here again both ends of the duct were isolated, and the gap was closed with a portion of the posterior rectus fascia sutured around a tube. Leakage occurred, and it was found later that the distal end of the transplant and the tube had broken down. Resuture with reinforcement of the junction by the gastrohepatic omentum was successful.

These operations may have a certain value where both ends of the ducts are isolated, but even then the operation will be associated with considerable technical difficulty, and there will always be some doubt as to whether the graft has taken. When the lower end of the duct is absent they will be of little avail.

v. *Indirect Implantation.*—Most of the modern operations are based upon the method advocated by Sullivan,[24] who inserted a tube into the proximal end of the duct and then implanted the distal end of the tube into the duodenum. The free portion of the tube was then wrapped round with omentum in the hope that a fistulous tract would thereby be formed, and would persist after the tube was passed. A valvular opening into the duodenum was insured by suture of the tube into the duodenum after the manner of the Witzel method of gastrostomy. Fowler[4] states that Sullivan[25] had but a single case which has remained perfectly well for eight years. Brewer[1] reported two cases, in one of which death occurred later, apparently from obstruction. Mann[15] also reports a case which was greatly improved five months after the operation, but had not yet passed the tube. Wilms'[28] five cases apparently all recovered in the end, but only after very prolonged treatment, more than one operation being necessitated in some of the cases. Fowler[4] performed the operation in one case where obstruction returned three months later, and a similar result occurred in a case of Hagler's,[9] where obstruction appeared seven months later and, post mortem, cholangitis with abscesses in the liver was found. Mayo[17] lays stress upon the fact that stricture is likely to occur ultimately; but if it can be combined with direct union of some portion of the duct, so that there is a partial lining of mucosa, this tissue may grow around and ultimately give satisfactory results.

On theoretical grounds the operation would certainly appear to be faulty. The tube being held in non-contractile tissue is unlikely to be passed; the wall of the duct is formed of omentum alone, and thus at best is a fistulous tract; stenosis is therefore very likely to occur and lead to a recurrence of the condition.

The difficulties and drawbacks which are associated with all of the above methods led me to devise an operation, which I first published in 1915,[23] and which I have used in six cases with entire satisfaction.

TECHNIQUE OF OPERATION.

Exposure is gained by an upper right pararectal incision. In passing, I may say that I now invariably use this incision for all cases of disease of the stomach, duodenum, and gall-bladder. I find that it gives an admirable approach and a perfect view, so that I have never found it necessary to employ the Kocher, Mayo Robson, or Bevan incisions. Being placed wholly to the inner side of the rectus muscle, it does not interfere with the nerve-supply, and thus can, if necessary, be carried from the costal margin to the pubes without leading to any permanent weakening of the abdominal wall. The common bile-duct is now laid bare; if there has been a prolonged biliary fistula, the lower end will probably not be discovered; if there is a stricture or carcinoma, this is removed, if possible, so that there now remains a condition in which the upper end of the duct is patent, but is separated by a wide gap from the duodenum, making a direct implantation impossible. The upper border of the duodenum is now drawn upwards and sutured, so that the gap is as far as possible reduced. The largest size tube that will enter the cut end of the duct is inserted, and sutured in position with plain catgut. A flap is then cut from the anterior surface of

the duodenum, and is turned downwards. The upper part of the resulting opening is sutured until it is only sufficiently large to admit the tube. The tube is then inserted, and the flap turned upwards over it. In the upper portion the edges of the flap are sutured around

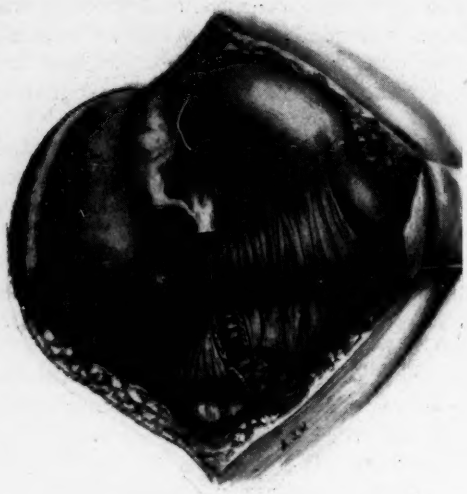


FIG. 154.—Showing duct divided and opening made into duodenum.

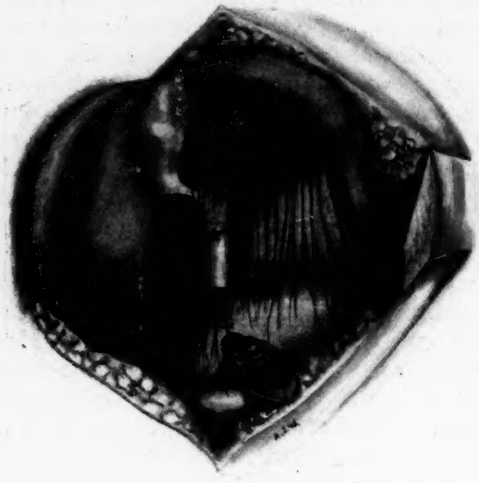


FIG. 155.—Tube sutured in duct. Opening in duodenum partly sutured.

the tube, and to the edges of the cut duct; below they are sutured to the wall of the duodenum which forms the structure adjacent to the posterior surface of the tube. For safety a small drainage tube is inserted down to the junction.

FIG. 156.—Tube inserted into duodenum. Duodenum drawn up as close as possible to common duct.

FIG. 157.—Duodenal flap sutured around rubber tube.

Figs. 154–157 *are reproduced from* '*Surgery, Gynecology, and Obstetrics*,' *Sept.*, 1915.

The operation in practice is very simple to perform. A new duct can readily be formed of practically any length; it is lined with mucous membrane, which is impervious to the action of the bile, and being lined by such a membrane will show no contraction; the tube

passes obliquely over the duodenal surface, and hence there will be a well-defined valvular action. Owing to the presence of the mucous-membrane lining it is not necessary for the tube to remain long in position. It can be sutured in place with plain catgut, which is dissolved in a few days, and thus there is little or no danger of the tube being retained.

Ginsburg and Speese[7] have suggested, as a modification of this operation, that the flap be turned upwards instead of downwards. They claim that by this means the suture will be easier, for the flap will lie behind the tube. It will also have a better blood-supply. This modification, however, does away with the important valvular nature of the opening. I tried it in one of my cases, and was not at all satisfied with the technique. The flap being turned upwards is angulated at its pedicle, and suture in this position becomes much more difficult. A comparison of the two operations leaves me strongly in favour of the view that instead of being easier to perform it is more difficult, and the opening into the duodenum is physiologically much less satisfactory. I have found the former method so easy and so generally satisfactory that I have made a slight modification of it for use in those cases in which there is an obstruction low down in the duct. In the cases already mentioned in which there is an obstruction due to carcinoma or chronic pancreatitis, and in which the duct has been opened for exploratory purposes, so that cholecystenterostomy becomes a risky procedure, it is a perfectly simple matter to insert the tube into the lateral opening of the common duct instead of into the cut extremity, and then to reconstruct the new duct from the duodenal flap around the tube, so that there is, in fact, a new duct entering the lower part of the original one at a slight angle. The results of my own cases are classified in the following three appendices :—

FIG. 158.—Acute cholecystitis. Accidental removal of portion of common duct. (*Appendix A, Case* 1.)

Appendix A consists of 4 cases in which an injury was overlooked, or some method other than the reconstruction was performed. Of the 3 cases in which some form of repair was carried out, 1 died, and 1 has had some evidence of further obstruction. Of the 6 cases in which reconstruction has been performed, the results are on the whole satisfactory.

Appendix B consists of 3 cases in which the new duct was joined to the end of the divided duct. One, which had carcinoma of the common duct low down, and also carcinoma of the gall-bladder, died after resection of both carcinomata and reconstruction of the duct. The other 2, who had benign obstructions, are in perfect health four years and eighteen months respectively after operation. It is interesting to note that in one patient the hepatic ducts were both divided, so that two tubes had to be inserted and the flap sutured around them both.

Appendix C includes 3 cases where the new duct was united to the side of the common duct. One, who had an advanced pancreatitis, died seventeen days after the operation ; but the tube had been passed and there was no evidence of leakage. The other 2 cases recovered completely from the operation, but since one of these had an incurable carcinoma of the common bile-duct and the other an advanced chronic pancreatitis, they are not free from symptoms. Thus, of 6 cases there are 4 recoveries and 2 deaths.

CLASSIFIED CASES.

Appendix A.—Cases Treated other than by Reconstruction Method.

***Case* 1.—Acute cholecystitis. Accidental division of common duct overlooked. Death.**

M. J. C. Patient, age 53. History of gall-stones many years.

Acute cholecystitis. Cholecystectomy, Feb. 25, 1913, commencing at cystic duct. Common duct accidentally overlooked and ligatured. Onset of peritonitis three days later.

Second operation.—Drainage of peritoneum. Died.

Post-mortem.—Division of common duct ligatured on both ends. Leakage from upper end. Peritonitis. Dissection of specimen revealed the presence of about one inch of common duct (*Fig.* 158).

***Case* 2.—Accidental division of common duct. End-to-end suture. Recovery.**

M. W. Patient, age 40. Gall-stones accidentally discovered by gynæcologist during operation for fibroids.

Cholecystectomy, Oct. 15, 1915, commencing at cystic duct. Accidental division of common hepatic and common bile-ducts. Immediate suture. Slight leakage of bile for nine days. Complete recovery.

FIG. 159.—Congenital absence of cystic duct. Two hepatic ducts entering the side of gall-bladder. Common duct emerging from opposite side.

***Case* 3.—Congenital absence of cystic duct. Division of hepatic and common ducts. End-to-end suture. Incomplete recovery.**

E. H. Patient, age 38. History of gall-stones five years.

Cholecystectomy, June 2, 1916. After removal, two hepatic ducts and common bile-duct found to be divided. Immediate end-to-end suture.

Dissection of specimen revealed two hepatic ducts entering one side of gall-bladder, and common duct emerging from the other (*Fig.* 159). Slight leakage of bile two and a half weeks. Passage of bile to intestine. Complete operative recovery.

Last note, Oct. 18, 1920. Keeping very well, but every few months has attacks of collapse, with a little pain, followed by profuse jaundice. Attacks last about two days, but are becoming less frequent, hence further operation not advised.

***Case* 4.—Gall-stones. Chronic pancreatitis. Cholecystoduodenostomy. Death.**

S. W. Patient, age 65. Ten weeks' history of pain and jaundice.

Operation, Jan. 28, 1920. Gall-bladder distended, many adhesions, many calculi. Three calculi in common bile-duct. Much dilated. Large mass in region of head of pancreas. Opening in side of common bile-duct directly anastomosed to opening in side of duodenum. Good progress for three days. Collapsed and died.

These cases may be tabulated thus :—

	Total	Died	Improved	Recovered
Overlooked division of duct	1	1	–	–
End-to-end suture after division	2	–	1	1
Lateral anastomosis for obstruction ..	1	1	–	–
	4	2	1	1

Appendix B.—Cases Treated by Reconstruction Method. New Duct joined to End of Divided Duct.

***Case* 1.—Early chronic pancreatitis. Exploration of duct. Permanent biliary fistula. Reconstruction of duct. Recovery.**

J. L. Patient, age 27. Eight years' history of pain and jaundice. Vomiting.

Operation, May 13, 1914. Gall-bladder not dilated. Common duct not dilated. Head of pancreas hard and nodular. Common duct explored. Passage not free. Sutured. Gall-bladder

drained. (It would have been better to have performed cholecystenterostomy). Developed permanent biliary fistula.

Second operation, June 3, 1914. Reconstruction of common bile-duct by flap method. Complete recovery with no leakage. Passed tube on 11th day.

Last note, Sept. 11, 1918. Perfectly well, except for occasional slight attacks of abdominal pain. Has served in the army through war. Fighting in Gallipoli, April to December, 1915.

Case 2.—**Cholelithiasis. Acute cholecystitis. Cholecystectomy. Exploration of common duct. Stricture of common duct. Biliary fistula. Reconstruction of common duct. Recovery.**

S. E. Patient, age 64. History of gall-stones several years. Severe pain twelve days.

Operation, Aug. 11, 1919. Gangrenous cholecystitis. Cholecystectomy. Stone in stump of cystic duct. Removed. Duct sutured. Developed permanent biliary fistula.

Second operation, Oct. 1, 1919. Opening found at junction of two hepatic ducts; stricture just below. Two hepatic ducts divided. Tube inserted into each. Flap made from duodenum and sutured around tubes. Uninterrupted recovery. Tubes passed on 14th and 15th day.

Last note, Feb. 4, 1921. Complete recovery. No pain, full diet, never any symptoms since operation.

Case 3.—**Cholelithiasis. Carcinoma of gall-bladder. Carcinoma of common bile-duct. Cholecystectomy. Reconstruction of common duct. Death.**

J. U. Patient, age 60. Thirty years' history of gall-stones. Constant jaundice ten weeks.

Operation, Jan. 19, 1921. Cholelithiasis. Carcinoma of gall-bladder. Cholecystectomy. Dilatation of common bile-duct. Carcinoma of common bile-duct just above duodenum. Growth resected. Tube inserted into upper end of common duct. Reconstruction of flap. Died four days later.

These cases may be tabulated thus:—

	Total	Died	Improved	Recovered
Chronic pancreatitis	1	–	–	1
Stricture of common duct	1	–	–	1
Carcinoma of duct and gall-bladder ..	1	1	–	–
	3	1	0	2

Appendix C.—Cases Treated by Reconstruction Method. New Duct joined to Side of Common Bile-duct.

Case 1.—**Chronic cholecystitis. Advanced chronic pancreatitis. New duct joined to side of common bile-duct. Death.**

W. E. Patient, age 48. Six months' history of pain and jaundice.

Operation, Aug. 1, 1917. Gall-bladder small and shrunken. Adherent to colon. Common duct dilated. Head of pancreas hard and enlarged. Cholecystectomy. Opening made in side of dilated common duct. Tube inserted and sutured. Flap of duodenum sutured around tube. Wound healed. Passed tube on 9th day. Gradually sank, and died seventeen days later.

Case 2.—**Cholelithiasis. Cholecystitis. Carcinoma at junction of ducts. New duct joined to side of hepatic duct. Recovery.**

A. M.—Patient, age 48. History of stones many years. Persistent jaundice 6 weeks.

Operation, Sept. 24, 1919. Liver enlarged. Gall-bladder distended. Full of stones and mucus. Growth at junction of hepatic, cystic, and common bile-ducts. Hepatic duct much dilated. Growth adherent to structures around preventing removal. Opening made in hepatic duct. Tube inserted. Modification of flap operation as suggested by Ginsburg and Speese performed. (This was not so satisfactory as the usual operation. The opening was not valvular, and it was more difficult to obtain accurate suture.)

Cholecystenterostomy then performed to allow of drainage of gall-bladder and cystic duct secretion. Primary union. Complete disappearance of jaundice in four weeks.

Last note, Feb. 6, 1920. No jaundice. Subject to attacks of pain and vomiting. Wasted. Great muscular weakness; probably progression of carcinoma.

Case 3.—**Carcinoma of head of pancreas or chronic pancreatitis. Failure of secretion of bile. Exploration of common bile-duct. New duct joined to side of common duct. Recovery.**

J. M. Patient, age 62. Persistent jaundice three months.

Operation, Oct. 6, 1920. Gall-bladder distended; no stones. Contained mucoid material suggesting cystic-duct obstruction. Common duct explored. Similar mucoid fluid. Hard mass

in region of head of pancreas. Tube inserted into opening made in common duct. Flap of duodenum sutured around tube. Gall-bladder sutured. Vomit contained bile second day after operation. Ten days later, stools coloured. No leakage of bile. Wound healed. Tube passed on 14th day.

Last note, April 14, 1921. No further jaundice. Weak. Considerable flatulence. Some attacks of pain much relieved by taking pancreatic extract.

These cases may be tabulated thus :—

	TOTAL	DIED	IMPROVED	RECOVERED
Chronic pancreatitis	2	1	1	–
Carcinoma of duct	1	–	1	–
	3	1	2	0

BIBLIOGRAPHY.

[1] BREWER, G. E., " Hepatico-duodenal Anastomosis ", *Ann. of Surg.*, 1910, June, 830.
[2] BREWER, G. E., " Observations upon the Surgery of the Biliary Passages ", *Surg. Gynecol. and Obst.*, 1912, May.
[3] ELIOT, E., " The Repair and Reconstruction of the Hepatic and Common Bile-ducts ", *Surg. Gynecol. and Obst.*, 1918, Jan., 81.
[4] FOWLER, F., " Reconstruction and Repair of the Hepatic and Common Bile-ducts ", *Surg. Gynecol. and Obst.*, 1918, Oct., 387.
[5] FULLERTON, A., "Anastomosis between the Common Bile-duct and the Duodenum for Obstructive Jaundice ", *Brit. Med. Jour.*, 1907, Oct. 26.
[6] GIACINTO and LUIGI, *Giorn. d. r. Accad. di. Med.*, Torino, 1914, v. 20.
[7] GINSBURG, N. and SPEESE, J., " Autogenous Fascial Reconstruction of the Bile-duct ", *Ann. of Surg.*, 1917, Jan., 79.
[8] GIORDANO, G. and STROPENI, L., *Centralb. f. Chir.*, 1914, xli, 190, and *Giorn. d. r. Accad. di. Med.*, Torino, 1914, v, 1.
[9] HAGLER, F., " Rubber Tube Reconstruction of the Common Bile-duct ", *Surg. Gynecol. and Obst.*, 1918, Oct., 689.
[10] HARRINGTON, *Boston Med. and Surg. Jour.*, 1909, clx, 203.
[11] HORZ, *Berl. klin. Woch.*, 1913, Jan. 27.
[12] JACKSON, R. H., " Anterior Choledojejunostomy ", *Surg. Gynecol. and Obst.*, 1914, xix, 232.
[13] JACOBSON, J. H., *Amer. Jour. Obst.*, New York, 1914, lxx, 948.
[14] LEWIS, D. D., and DAVIS, C. B., *Trans. West. Surg. Assoc.*, St. Louis, 1913, Dec.
[15] MANN, A. T. " A Rubber Tube in the Reconstruction of an Obliterated Bile-duct ", *Surg. Gynecol. and Obst.*, 1914, xviii, 326.
[16] MAYO, W. J., *Ann. of Surg.*, 1905, Aug.
[17] MAYO, W. J., " Restoration of the Bile-passage after Serious Injury to the Common or Hepatic Ducts", *Surg. Gynecol. and Obst.*, 1916, Jan., 1.
[18] MOLINEUS, *Deut. Zeits. f. Chir.*, 1913, March.
[19] PACKARD, H. " Permanent Stenosis of the Ductus Communis from Inflammatory Infiltration or Cicatricial Contraction of a Duodenal Ulcer ", *Boston Med. and Surg. Jour.*, 1908, July 23.
[20] PHEMISTER, D. B., " Reconstruction of the Hepatic Duct ", *Surg. Clin. of Chicago*, 1917, June,
[21] RIGGS, T. F., " End-to-end Suture of the Bile-ducts ", *Surg. Gynecol. and Obst.*, 1916, June, 660.
[22] ROLLESTON, SIR H. D., *Diseases of the Liver, Gall-bladder, and Bile-ducts*, London, 1904.
[23] SASSE, *Arch. f. klin. Chir.*, 1913, 969.
[24] SULLIVAN, A. G., " Reconstruction of the Bile-ducts," *Jour. Amer. Med. Assoc.*, 1909, liii, 774.
[25] *Ibid.*, 1912, lviii, 2026.
[26] SWAIN, W. P., " A Case of Cholecystenterostomy with the use of Murphy's Button ", *Lancet*, 1895, 1, 743.
[27] WEIDEMANN, H., *Beitr. z. klin. Chir.*, 1914, lxxxix, 599.
[28] WALTON, A. J., " Reconstruction of the Common Bile-duct ", *Surg. Gynecol. and Obst.*, 1915, Sept., 269.

STUDY OF SOME METHODS OF BONE-GRAFTING.

By MAUD F. FORRESTER-BROWN, Edinburgh.

In the following article no attempt is made to settle finally the vexed question as to which method of dealing with ununited fractures is the best, because the number of cases at the author's disposal is not sufficient to warrant dogmatic statements; moreover, it is probable that in this, as in other branches of surgery, each method has its own special indications, nor is any one adapted to all cases. It is hoped that a study of the following groups of cases treated by various methods may be helpful in illustrating the advantages and limitations of the different types of operation.

The cases recorded were all sooner or later in wards under the writer's care, with the exception of two, which are published by kind permission of Sir Harold Stiles, as they illustrate well the fate of grafts in the form of bone-chips. Owing to various administrative changes, most of the cases had been operated on at least once before coming under the writer's care, while some of the later ones were operated on by her assistants, but no cases are recorded whose progress had not been personally followed.

They have been chosen not as typical of the work at Bangour, but to illustrate special difficulties which confront the surgeon who deals with non-union following septic fractures, and the drawbacks and advantages of the various methods available. For this reason a large proportion are cases where several attempts had to be made before a successful result was attained, and in a few it was not attained while the patient was still in the hospital. In the writer's experience, it is by his failures that a surgeon and his friends learn most, and one failure is often more instructive than half a dozen successes; mere tables of good results are of little value to the student, however desirable from the patient's point of view. The surgeon who approaches a new field wishes to know the possible pitfalls, and unfortunately in bone-work they are many.

The guiding principles in all these cases seem to be:—

1. Wide opening-up of vascular bone, so as to give as many osteophytes as possible access to the seat of fracture.

2. The preliminary counteraction of all deforming tendencies, which are usually due to the simultaneous involvement of the soft parts.

3. The protection of the bone from undue stress subsequent to the operation. This is attained best, in the writer's view, by the application of a plaster-of-Paris cast at the time of operation, which eliminates the risk of slipping of the support, or interference with the position by patient or nursing staff. It enables the patient to get about freely at an early period, even with lower-limb injuries. It exerts an even pressure, and so interferes but little with nutrition of the parts and the shape of the muscles.

4. As soon as the ends of the bone are tied together by soft callus, so that they cannot get separated by soft parts, stimulation of the bone by local heavy massage and use of the limb in a support which will prevent deformity.

The operative methods available for dealing with an ununited fracture, which has no chance of spontaneous union owing to the intervention between the bone-ends of some other tissue, are:—

1. *Rawing the ends*, preferably with stepping, so as to secure some mechanical safeguard against separation of the ends and to increase the surface of contact. This usually needs to be reinforced by the use of some form of ligature, either wire or strong catgut, which is best passed through holes drilled in the bone-ends.

2. The use of numerous *small bone-grafts*, as sources of osteoblasts, to supplement the osteogenetic powers of the bone-ends. These chips of bone may be derived from the

neighbourhood of the fracture, or from some other bone, the iliac crest being the best source of vascular cancellous bone.

3. *A sliding graft*, i.e., a slice of bone from the surface of one fragment, which is slid across the gap and brought in contact with a specially-rawed area on the surface of the other fragment.

4. An *intramedullary peg-graft*, usually derived from some other bone.

5. An *inlay graft* from some other bone, usually the tibia, which provides a considerable length of dense bone adapted for this form of 'internal splint'.

6. *Plating.* This method provides an internal splint of great mechanical strength, but of a substance foreign to the organism, and therefore liable to cause irritation, and possibly to be ultimately extruded.

7. *Grafts of ivory* or *boiled bone*, either human or animal, which may be used either as intramedullary or lateral grafts.

THE TWO-STAGE OPERATION.

We will deal in turn with each method, referring to its special advantages and drawbacks, and illustrating these as far as possible by case records; but before discussing the first method, the writer wishes to draw attention to the great benefits of what may be called the *two-stage operation* in dealing with ununited fractures, more especially those due to war injuries. By this is meant the use of a preliminary operation at which as much scar tissue as possible is excised, particularly that over the bone-ends, including the sclerosed portions of bone, while all contractures and other static deformities are overcome, often with the assistance of a plaster cast to maintain correction. If primary healing occurs, a second operation, at which the actual graft is introduced, is done two weeks later. The advantages of this are twofold:—

FIG. 160.—Pte. S. Ununited radius with much radial deviation of hand. Before operation.

a. It prevents mechanical strain on the bone-graft, which, when of more than slight degree, is a fruitful source of non-union. This strain is usually due to the anchoring effect of scar tissue, or to shortening of the muscles, which has been allowed to occur while the fracture was ununited. Unless the scar tissue has been freely excised and the muscles have been stretched by a plaster splint, the bone-graft is not able to resist them, no matter what mechanical means, in the form of carpentry or wire ligatures, are adopted to reinforce it. Though wire does not itself yield early, yet it cuts through the bone as if that were cheese, and therefore fails to maintain its support. Indeed, the writer has found that wherever the strain is greater than can be borne by thick iodine-tannic catgut, then, if wire is used, the bone will be cut. This is a serious drawback to the use of wire, because, as it is usually applied one inch or more from the end of the bone, it isolates that length from its blood-supply; and by so much lengthens the gap to be bridged at a subsequent operation. As wire has the additional disadvantage

FIG. 161.—Same case as *Fig.* 160, after second operation (lateral tibial graft into radius).

of being a foreign body, liable in itself to cause rarefaction of bone and irritation, and certain to prolong any flare-up of the original sepsis, there seems no reason for its use.

b. The second advantage of the two-stage operation lies in its connection with the *prevention of flares-up of sepsis.* The organisms to which these are due lurk in the scar tissue, especially that part which has invaded the ends of the bone, and therefore, the more radically the scar is excised, the fewer of these organisms are left. As it is usually impossible to resect the scar without cutting into it, it follows that a few organisms are likely to be set free, and if at the same time a piece of isolated tissue like a graft is left with them it may form a pabulum for them, so that an infection will result, which otherwise could have been stamped out by the vascular tissues of the neighbourhood. Secondly, the dissection necessary to freshen the ends of the bone satisfactorily, with the inevitable opening up of scar tissue, makes complete hæmostasis difficult; whereas this is not so at the second operation, when the bone can be exposed with little disturbance of surrounding tissues: the occurrence of a hæmatoma seriously imperils the success of a graft operation.

FIG. 162.—Pnsr. B. Ununited ulna after first operation (trimming ends). Arrows mark a previous graft united at one end only, owing to sepsis.

FIG. 163.—Same as *Fig.* 162, after second operation (lateral tibial graft into ulna).

If a flare-up occurs after the preliminary excision of scar, the surgeon has good warning that the time is not ripe for grafting, while the infection usually pursues a mild course, there being no interference with drainage and no foreign material to keep it up. In such a case it is difficult to know when it will be safe to put in a graft. If there is sufficient skin available to allow of a second excision after a period of heavy massage has failed to evoke a flare, the graft may safely be proceeded with. Fortunately, few such cases occur; and it is probable that heavy massage to the bone-ends, by inducing a repeated mild auto-inoculation, would enable the patient to destroy the remaining infectious organisms, especially as their original lurking-place, the heavy bed of scar, which had been slowly formed in the original virulent infection, has been removed.

As a post-operative infection is generally fatal to the vitality of part or all of the graft, and is the commonest cause of non-union after grafting, it is most desirable to avoid it; and it is well worth the patient's while to undergo the moderate discomfort of a second anæsthetic, especially as this procedure shortens the length of the second operation, which otherwise is apt to be tedious.

Most surgeons who have had to deal with the late effects of war injuries have drawn attention to the impossibility of judging by ordinary methods when the original infection is extinct, and not merely quiescent, no known time-limit being in itself a guarantee.

The writer has not met a case where this procedure was adopted and where a flare-up occurred after the grafting, and it was more particularly used in cases with a history of severe and prolonged sepsis, or where a previous grafting operation had been spoiled by infection; this speaks strongly for the procedure, even on a small series of cases.

The following two cases illustrate the points raised above :—

Case 1.—Pte. S., age 34. (*Figs.* 160 and 161.)
April 9, 1918. Gunshot wound, with gap fracture of radius. *Aug.* 19 : First bone-graft operation at previous hospital. Suppuration for seven months. Sequestrum removed. *June* 19, 1919 : Admitted to Bangour. *Aug.* 27 : Excision of scar—correction of deformity, both pronation and radial deviation—plaster cast. *Oct.* : Bone-grafting, large tibial graft applied to rawed posterior surface of radius, tied by tannic catgut. Plaster dressing. Primary healing. Good function finally, but only after several tendon-transplantation operations.

Case 2.—Pnsr. B., age 25. (*Figs.* 162 and 163.)
Aug., 1918 : Wounded. *Dec.* : Healed. *June*, 1919 : First bone-graft operation, followed by flare-up. *Jan.*, 1921 : Admitted to Bangour with severe scarring and ununited fracture of the ulna. Graft had united to the lower fragment. Excision of scar and trimming of bones. Graft from tibia, 5 in. long, to surface of ulna, and another, 1 in. long, between its ends. Plaster case in which a window was cut three days later. Primary healing, and bony union in due course.

There is no doubt that the method of applying a strong lateral graft to act as an internal splint, and then using other fragments, which require no stability but only a large raw surface, to fill the space between the actual ends of the bone, gives excellent results. In the case of a large bone like the humerus, it is often useful to put the central graft into the medulla of one or both fragments, to prevent its displacement, which is more apt to occur where there is not a second bone acting as a splint, as there is in the forearm.

Method 1.—STEPPING BONE.

The method of rawing the ends of the bone and stepping them so that the raw surfaces fit together in an L-shaped manner is obviously inapplicable to a single bone in the forearm or leg, where the second bone splints it and keeps the ends apart. It can be used in such a case if the second bone is divided and stepped also, and this is a desirable procedure in a certain type of forearm injury, which will be discussed later. Stepping is particularly applicable to ununited fractures of the humerus, for the inevitable shortening is not a serious disability, unless it reaches extreme limits. In the case of the femur, shortening beyond 2 inches is a serious handicap, so that the method is only applicable to certain cases.

The great advantage of this method is that it can be utilized in the presence of infection, e.g., during the removal of sequestra, so that by the time healing has occurred union is also firm, and the patient is saved the long waiting period which otherwise would be necessary before any grafting operation was safe. In the arm, the cases where non-union occurs usually have scar tissue through its whole thickness, involving the main vessels and nerves, so that the radical excision advised above can seldom be carried out. It is therefore usually wise, when removing the scar or sequestra, to freshen and step the ends of the humerus without stripping periosteum more than possible, and then to ligature the ends with strong catgut, which serves to hold them together while a plaster-cast is applied, but comes away quickly if there is suppuration. If the cast is strongly reinforced in the axilla, large windows can be cut for the dressing, or indeed a whole lid, so that sepsis is no bar to its application. On the contrary, the rest which it offers by fixation is a most valuable factor in promoting healing.

The following cases illustrate the advantages of this method. They had all active or recent sepsis, and it is almost certain that other methods, such as grafting or plating, would have failed to secure union, and would assuredly have resulted in much more severe suppuration.

In connection with the subject of stepping bones, it may be well to say a word as to the advisability of shortening one bone of the forearm where the other is ununited. The dangers of this procedure are : (1) Non-union may result in the second bone, especially as the fragments are difficult to control when both bones are loose. (2) The second bone may become infected if a flare-up occurs. (3) There may be slack in the muscles which might interfere with their function. This last is a purely theoretical objection, as the

muscles adapt themselves with extraordinary rapidity; but the two former ones are real and grave. They can be guarded against largely by shortening the healthy bone as a separate operation through an incision planned to avoid scar tissue; unfortunately, if the fractured bone is not exposed at the same time, it is usually impossible to get sufficient overlap of its fragments to allow of subsequent apposition after trimming; however, it is often sufficiently useful to reduce the gap between the ends without actually annihilating it.

There is one great indication for shortening the forearm which, in the writer's opinion, can be satisfactorily dealt with in no other way, namely, contracture of the radial tendons, and loss of skin and soft parts in cases of ununited radius, to such an extent that the skin would not meet over a bone-graft, while correction of the extreme radial deviation of the hand would not be possible. In such cases some surgeons lengthen the tendons, which are stretched like a bow-string across the defect in the bone; but as the sutured tendons and the graft lie under a wide skin scar, adhesions are almost certain to impair their function, even if the skin does not actually slough away over them. On the other hand, if the ulna be shortened, the skin on the radial side will be so much relaxed that it is usually possible to excise the scar altogether, while the tendons attain a normal tension. It is extraordinary what good function the tendons have in some of these cases where they run through a mass of scar, so long as their sheaths are not opened by the surgeon. Non-union of the ulna only is very rarely an indication for shortening the radius.

In the case of the leg, the shortening is usually undesirable, but occasionally, with a septic ununited fracture of the tibia with malposition of the fragments, it may be wise to divide the fibula obliquely, so as to let it shorten, in order to get the fragments of tibia into line and contact; if spontaneous union does not then occur, it will be much easier to get satisfactory union later by a sliding graft than if the ends were separated by much scar and were lying at an angle to one another. *Case* 3, recorded below, illustrates the advantage of this method. The following are cases where shortening of the ulna seemed advisable and gave a good result. In *Case* 5, the shortening allowed a contracture of the flexors of the wrist to be overcome, and the median nerve to be sutured across a gap, without reproducing the contracture by the need of flexing the wrist, which would otherwise have occurred.

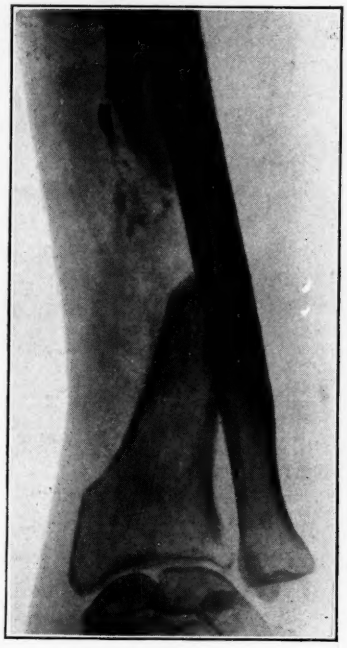


FIG. 164.—Sgt. C. Ununited radius with much deviation—before operation.

FIG. 165.—The same patient as *Fig.* 164, after operation. Ulna shortened: sliding graft of radius. (The figure has been reversed in photographing.)

CASES WHERE FOREARM WAS SHORTENED FOR UNUNITED FRACTURE OF RADIUS.

Case 3.—Sgt. C., age 28. (*Figs.* 164, 165.)

March, 1918: Wounded, gap fracture of left radius. *May*: Wound healed. *July*: Admitted to Bangour, with 1-in. gap in left radius and much deviation of hand. *Sept.*: Ulna shortened and united by step and autogenous bone-peg. Ulna united, but radius did not. *March*, 1919: Radius

exposed, sclerosed bone removed, leaving gap of 1 in.; a 4-in. sliding graft taken from upper fragment and laid across gap, whilst piece cut to make trough in lower fragment was placed in the gap. *June*: Union fair. Ultimate result excellent.

Case 4.—Rfm. G., age 30. (*Figs.* 166, 167.)

1919: Wounded. *July*, 1919: Admitted. Muscle contraction of fingers, radius had a 2½-in. gap with extreme deviation of hand. *Oct.*: Excision of wound scar. *Jan.*, 1920: Ulna shortened by 2½ in., with shortening of extensor ulnaris tendon. *June*: Bone-graft from tibia to radius, which on account of sclerosed ends had not united. Plaster worn for ten weeks, at end of which radius was firmly united with hand in good position.

FIG. 166.—Rfm. G. Ununited radius; extreme deviation of hand—before operation.

FIG. 167.—Same case as *Fig.* 166, after operation. Lower end of ulna removed; tibial graft.

The radius practically never unites unless it is exposed and freshened at the same time that the ulna is shortened. This procedure is, in the writer's opinion, seldom justifiable, on account of the risk of infecting the ulna from scar tissue, and also because the fragments are much more difficult to control when both bones are quite free; for although the radius is always ununited, yet its ends are much steadied by the scar tissue, and it forms a fulcrum in dealing with the ulna.

Case 5.—Pte. N. (*Figs.* 168, 169, 170.)

August, 1917: Wounded. *March*, 1918: Admitted, the skin wound having just healed. Gap fracture of radius with fixed pronation and extreme radial deviation, median paralysis, contracture of wrist and fingers in flexion. *March*: Ulna shortened by 1½ in. over an autogenous intramedullary peg. Supination attained later by a series of plasters. *July*: Median nerve sutured. *Sept.*: Radius still ununited, ends refreshed, and sliding graft brought across the gap. Union unsatisfactory, so that radius became angulated. *Feb.*, 1921: Useful function, but *x* rays indicated a false joint in the radius. This occurred because the sliding graft used was too small to stand the strain. Nerve recovered completely.

The following case is instructive as showing the danger involved in shortening the forearm; it also illustrates one of the disadvantages of wires, but shows that a good result can be attained in the most difficult case, if surgeon and patient do not allow themselves to be discouraged by a previous failure.

Case 6.—Pte. Mc.G., age 35. (*Figs.* 171 and 172.)

Oct., 1917: Wounded. Healed six months later. *Oct.*, 1917: Admitted, gap fracture of radius with septic wound leading down to it. *Jan.*, 1918: Sequestra removed, healed in ten weeks: *May*: Ulna shortened by ¾ in. and fixed by medullary peg. Ulna did not unite because the peg slipped out of place. *Oct.*: Ends of radius freshened and tied with tendon sutures. Union did not occur. *Feb.*, 1919: Radius united by step-cut operation, primary healing, but non-union. *May*: Both bones exposed, stepped, and wired. Plaster. *July*: Inlay graft from tibia to radius, which was tied in place by wire. Non-union of graft at upper end. *Dec.*: Wires removed, ends of bone refreshed; plaster. Feeble union. *Feb.*, 1920: Ulna treated by a sliding graft. *July*: Both bones firmly united.

The interesting points about this case are:—

1. That the methods of fixation which are commonly supposed to give mechanical stability failed to do so, but did interfere with callus formation.

FIG. 168.—Pte. N. Ununited radius; much deviation and contractures—before operation.

FIG. 169.—Same case as *Fig.* 168, after first operation. Ulna shortened; intramedullary peg.

FIG. 170.—Same as *Fig.* 168, after second operation. Small sliding graft of radius.

FIG. 171.—Pte. McG., after tibial graft of radius. Wire and necrosed upper end of tibial graft have been removed; wire of first operation still on ulna.

FIG. 172.—Same case as *Fig.* 171, later. Radius now united; sliding graft of ulna uniting well. Note increase of callus on radius since removal of wire.

2. That union was finally attained by very simple methods when the bones were extensively rawed, and fixed just enough to prevent displacement till a cast was applied; there was then no interference at all for four weeks, after which a second cast was most carefully applied and worn another four weeks. In these cases, where some factor has prevented primary union of a fracture, it seems to take about eight weeks for any union to stand strain; in other words, the rules which can be applied to most simple fractures do not hold with these cases.

STEPPING FOR UNUNITED FRACTURE OF HUMERUS.

Case 7.—Pte. N., age 28.

May, 1918: Wounded. *Sept.*: Admitted. Septic wound leading down to comminuted fracture of humerus. Ulnar paralysis. Arm in straight Thomas splint. *Oct.*: Removal of small sequestra, large fragments with periosteal attachments left in place. *Dec.*: Further sequestra removed; arm and chest put up in plaster, with windows for dressings. *April*, 1919: Fracture exposed; further sequestrum and much scar tissue removed from between the fragments. Fragments shaped like steps and united by wire, which had subsequently to be removed. In attempting to flex the elbow, the olecranon was fractured. *July*: Fracture united. Ulnar nerve sutured.

FIG. 173.—Cpl. R. After operation. Humerus stepped; united.

Case 8.—Pte. J.

Ununited comminuted fracture of lower end of right humerus with fixed elbow. Step-cut operation, the fragments being tied together with tendon sutures. Some sequestra were removed. The elbow was forcibly straightened and the hand supinated, whilst the lower humeral fragment was held in a lion forceps. Put up in plaster case which included the chest and forearm. Plaster removed in six weeks. After ten weeks the fracture was firm and the elbow had a range from 90° to 130°. Rotation of hand for about half a circle.

Case 9. — Cpl. R. (*Fig.* 173.)

Septic comminuted fracture of middle of humerus. *May*, 1920: Step-cut operation on humerus with removal of sequestra; some pus was present. Fragments drilled and tied with tannic catgut. *Sept.*: Humerus well united. Sequestrum removed. *Oct.*: Tendon transplantation for musculospiral paralysis.

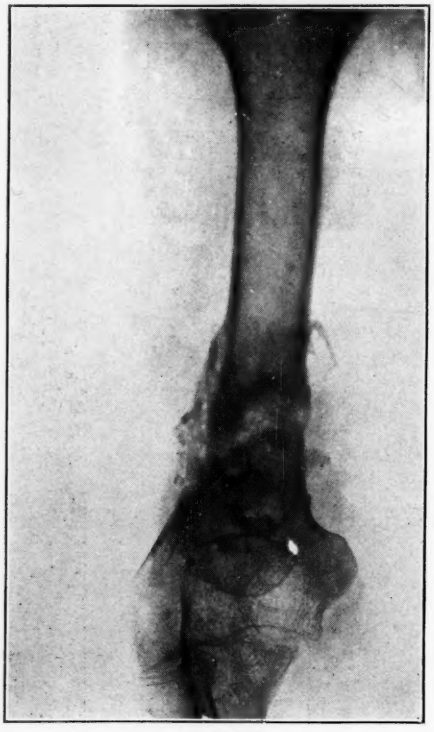


FIG. 174.—Pte. M. After operation. Humerus stepped; united.

In this, as in the other cases quoted above, any attempt to restore the normal length of the limb by grafting would have meant an indefinite postponement of recovery, while waiting for the sepsis to subside; or, if attempted early, would almost certainly have been doomed to failure.

The following case illustrates the failure of plating before the sepsis was quiescent, while stepping gave union under the same conditions. Incidentally, the reaction caused by the plating induced a paralysis of the musculospiral, which cleared up after union had occurred.

Case 10.—Pte. M., age 22. (*Fig.* 17.)
May, 1918: Wounded. *June*: Fragments of bone removed from humerus. *Feb.*, 1919: Further sequestra removed. *April.* Humerus plated, wound left open and treated by Carrel-Dakin method. Musculospiral paralysis appeared. *Aug.*: Plate removed because the wound had not healed. *Feb.*, 1920: Step-cut operation with catgut fixation. Plaster-cast including chest and forearm. Slow after-progress with removal of sequestra. Gradual improvement of musculospiral paralysis. *Feb.*, 1921: Union.

FIG. 175.—Pte. P. Ununited humerus, before operation.

FIG. 176.—Same case as *Fig.* 175, after operation. Humerus stepped; united; some bowing, but good function.

Case 11.—Pte. P. (*Figs.* 175, 176, and 177.)

This fifth case showed a similar course, except that the sepsis was less active and union occurred much earlier.

The skiagrams show that there was some forward bowing after union, but this gave no disability. In this case there was no interference with the forearm branches of the musculospiral, but those to the outer and inner heads of the triceps had been destroyed, with the corresponding segment of humerus, by the bullet; the long head worked, but this loss and adhesions of the biceps interfered somewhat with the function of the limb.

This illustrates a point which should never be lost sight of in these cases of

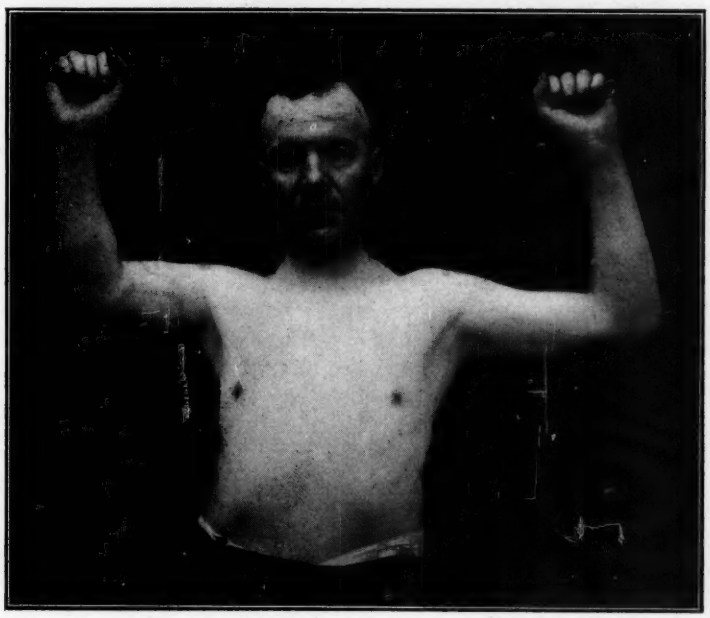


FIG. 177.—Same case as *Fig.* 175. Photograph to show amount of shortening.

ununited fracture, namely, that the injury severe enough to cause non-union has usually done irreparable damage to other structures besides the bone, and the repair of the latter alone is seldom sufficient to restore usefulness to the limb.

The sixth case of this series failed to get union by the stepping operation, but sufficient stability and shortening were obtained to enable the musculospiral nerve to be sutured easily. A bone-graft operation was intended to be done when the sepsis was likely to be quiescent, but the man has failed to return for this so far.

Case 12.—Pte. C. R., age 28.
Sept., 1918: Wounded. Fracture of humerus, with musculospiral paralysis. *July*, 1919: Removal of sequestra. Distal fragment impacted into proximal, and tied by tendon sutures. These slipped whilst plaster was being applied. *Oct.*: Step-cut operation; ends of bone drilled and tied together. Non-union persisted. *May*, 1920: Musculospiral nerve sutured. *July*: Patient transferred and lost sight of.

SHORTENING TIBIA.

The following case shows that the method of shortening and stepping a bone may occasionally be applicable to the bones of the lower limb, though the serious disability entailed by much shortening usually contra-indicates it there. In a case like the following, where the presence of deep sequestra necessitated an extensive operation, while the sepsis would delay any grafting operation, the other procedure is valuable, as well as much speedier.

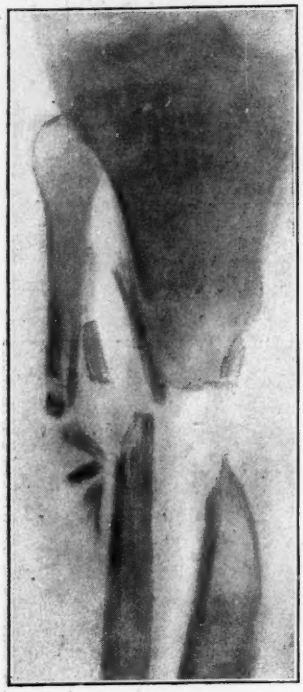


FIG. 178.—Pte. C. Ununited tibia, before operation.

Case 13.—Pte. C., age 20. (*Figs.* 178, 179.)
Sept., 1918: Wounded, comminuted fracture of tibia and fibula. *Oct.*: Admitted, open gap fracture of tibia with overlapping fracture of fibula. Plaster case from groin to toes. *June*, 1919: Union of fibula divided and fragments allowed to overlap further. Tibia cleaned, lower end impacted into upper. *Nov.*: Allowed to walk with leg-iron. *July*, 1920: Wound healed, can walk without support. Shortening of $1\frac{1}{4}$ in.

FIG. 179.—Same case as *Fig.* 178, after operation. Pointed lower fragment of tibia wedged into cavity in upper end, after freeing fibula; union.

In the above case, the extensive destruction of soft parts over the site of fracture, and the virulence of the sepsis, would have jeopardized the vitality of any graft.

The case also illustrates the advantages of the ambulatory treatment of such injuries in plaster, for from the moment the cast was applied the daily dressing became painless; the man was able to benefit by fresh air and bodily exercise and social intercourse; and the nursing of the case was reduced to a minimum, which was an important consideration in those days of overworked staff. In fact, although the man had a most tedious and disabling lesion, yet he was able almost to lead the life of a normal individual.

Method 2.—SMALL BONE-GRAFTS.

The following cases illustrate the value and limitations of the use of small chips of bone from the iliac crest, sown between the bone-ends to fill in a gap. The advocates of this method point out that it gives the maximum of raw bone surfaces, and therefore, presumably, the maximum escape of living osteoblasts, on whose activity the success of all bone-grafting operations depends; moreover, the bone used is of a very vascular type. The opponents of the method point out that it provides no primary mechanical stability, as does the intramedullary peg, and they assert that these small fragments become isolated and tend to absorb after a time, even if at first they increase in size by new growth of bone. The following cases show that they may survive for periods of one or two years, and during that time produce a great improvement in the limb, which one can scarcely believe will be lost later. In the cases quoted, the grafts formed considerable masses of bone, but did not cause bony union of the shafts between whose fragments they were placed. This suggests that the mean view is the just one in this as in most controversies, so that while these grafts have their value as a source of new bone, yet they need to be supplemented by the addition of an inlay or peg graft, if a bony ankylosis is desired. These iliac grafts are indicated for large gaps in thick bones, for which a bridging graft of equal diameter cannot be obtained, and also to replace the enlarged end of a bone, where a joint is flail from its destruction.

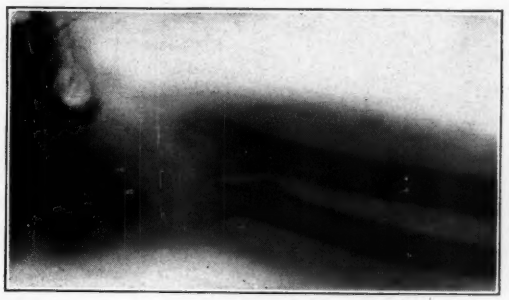


FIG. 180.—Pte. B. Flail elbow; loss of humeral condyles and olecranon.

All the three following cases had a loss of at least 2 in. of the humerus: in one the lower end, in the second 1 in. above the elbow, and in the third at the middle of the shaft. In each case the limb was flail and quite useless before the operation. In each, after operation, a mass of bone formed and filled the gap; and though the union remained fibrous, being short it was stable, so that the strain was reduced to a minimum. which much simplified the further plastic procedures that were undertaken. In the case of the flail elbow, after repair of the triceps tendon, the joint remained movable and useful for light work, which the man, being a clerk, preferred to an ankylosis. One of the humerus cases also regained control of the limb even while the union was fibrous.

Unfortunately, the skiagrams of the conditions before operation got broken at an early stage.

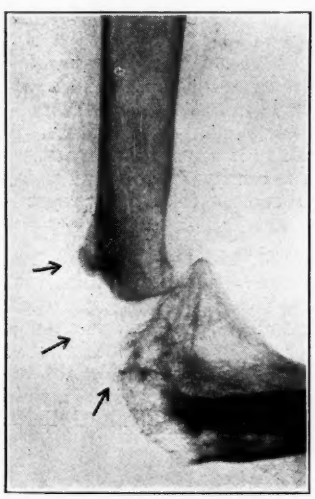


FIG. 181.—Same case as *Fig.* 180, after first operation (chips from ulna sown in gap).

FLAIL ELBOW TREATED BY CHIPS OF BONE FROM ULNA.

Case 14.—Pte. B. (*Figs.* 180, 181.)

April, 1918: Wounded, comminuted fracture of lower end of humerus, treated by immediate resection of the condyles of the humerus, resulting in a flail elbow. *July*: Scar tissue excised, bones forced together and sutured by periosteum. Elbow kept in successive windowed plasters till *Dec.* *Jan.*, 1919: Ends of bone sawn off, divided up into small chips, and planted round. Kept in plaster till *June.* Much lateral mobility remains. *Sept.*: Triceps tendon reconstituted by turning up a flap from ulnar periosteum. *Jan.*, 1920: Bones refreshed, humerus placed in front of ulna and fixed by a nail through the skin. *May*: Lateral mobility cured; can lift a chair and put hand to mouth.

UNUNITED HUMERUS TREATED BY CHIPS OF BONE FROM ILIAC CREST.

FIG. 182.—Capt. L. After first operation (wired).

FIG. 183.—Same case as *Fig.* 182, after second operation (chips from iliac crest sown in gap).

FIG. 184.—Same case as *Fig.* 182, 8 months later. Fibrous union, but limb stable (chips survive).

FIG. 185.—Same case as *Fig.* 182. Still fibrous union; chips survive 9 months after operation.

Case 15.—Lieut. A.

April, 1918: Wounded. Fracture of humerus with musculospiral paralysis. Loss of 2½ in. of humerus. *Aug.*: Foreign body removed and abscess drained. *Jan.*, 1919: Ends of humerus refreshed and wired, more débris being removed. *Sept.*: Ends of bone refreshed and the gap filled by chips from the iliac crest. *June*, 1920: Non-union persists. Intramedullary graft from tibia, together with further chips from iliac crest. (Further progress unknown.)

Case 16.—Capt. L. (*Figs.* 182, 183, 184, 185.)

Oct., 1917: Bomb wound, 2 in. blown away from left humerus. *March*, 1918: Bone-ends refreshed. One separated fragment used as an intramedullary graft. *Oct.*: Non-union. Bone-ends freshened and tied with kangaroo tendon. Plaster. *June*, 1919: Humerus step-cut and wired. *Oct.*: Non-union; wire removed; bones refreshed and gap filled with chips from iliac crest. *June*, 1920: Still some movement at fracture, but fair voluntary control of limb. Tendon transplantation for musculospiral paralysis.

Method 3.—SLIDING GRAFT.

The sliding graft is one of the simplest, and in many cases a most satisfactory one. Its advantages are that, coming from the very bone to which it is to be applied, it corresponds exactly in structure to the host, i.e., in the proportion of cancellous to ivory bone, etc.; moreover, it is quickly applied in its new bed, so that there is no fear of its suffering from cooling or excessive handling.

The disadvantages are that it is not nearly the calibre of the missing part which it has to replace, nor can it usually be taken large enough to withstand strain. For this reason it should not be relied upon alone where any but the shortest gap has to be bridged.

The sliding graft is most effective in dealing with non-union of the tibia when the ends of the bone are almost in contact; if they are first freshened and placed in line, and then the Albee's saw is run continuously down from one fragment to the other, a graft will be cut from the longer fragment which fits exactly into a groove in the shorter one, the piece of bone removed from this latter being utilized to lie beside the other at the gap between the bone-ends, so that the two together practically restore the original calibre of the bone.

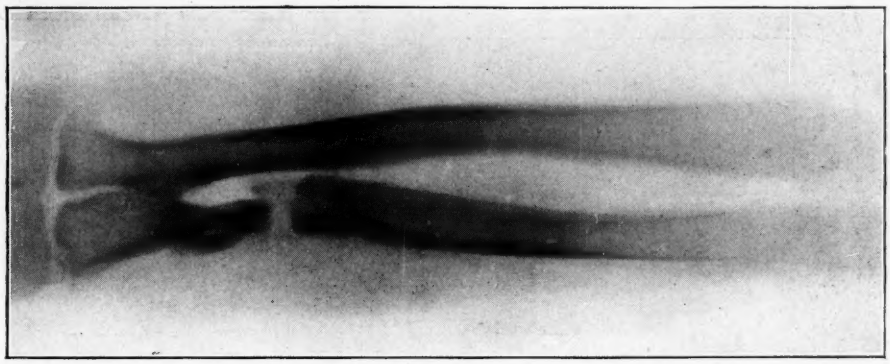


FIG. 186.—Dvr. H. Ununited ulna, after first operation (trimming ends).

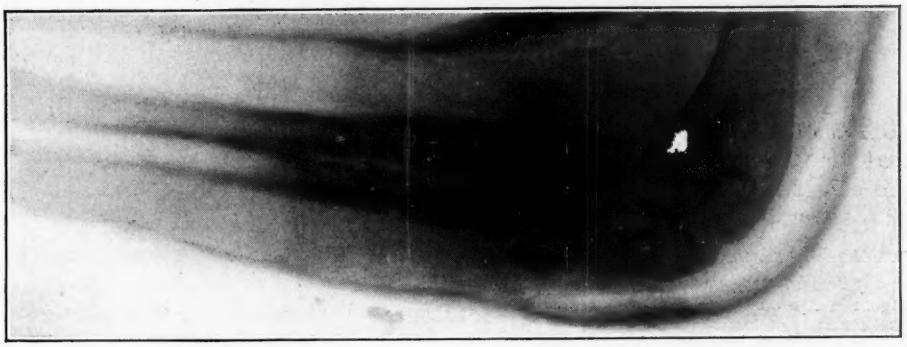


FIG. 187.—Same case as *Fig.* 186, after second operation (intramedullary graft from tibia).

The radius is another bone which adapts itself to sliding grafts, especially when the gap has been obliterated by shortening the ulna. The graft is best sliced up with a very wide gouge, which peels it up like a wood-shaving, the curve of the gouge just preventing splintering. A corresponding area on the shorter fragment is rawed by the gouge, and then the graft tied to both fragments by iodine-tannic catgut ligatures (Nos. 2 or 3).

The ulna being a less vascular bone than the radius, with usually a considerable thickness of sclerosed bone at the common site of non-union in the upper third, it is less often suited to the sliding graft. Two of the following cases, however, show that it can be useful. The case quoted above (Sgt. C., *Case* 3) shows the excellent result which can be obtained on the radius.

Successful cases of sliding graft of the tibia are common in every orthopædic hospital, and illustrate no special point to make them worth recording.

Case 17.—Dvr. H. (*Figs.* 186, 187.)

Sept., 1917: Wounded. *Feb.*, 1918: Ununited fracture of ulna. Operation for cleaning ends of bone. *May*: Graft from tibia driven into lower fragment, and wedged against side of upper

fragment. *Aug.*: Non-union between upper end of graft and upper fragment. *Dec.*: Sliding graft from lower fragment and first graft, over the gap—united by catgut. *April*, 1919: Good union, good function.

This case shows that even a large intramedullary graft does not necessarily give mechanical stability, while union was ultimately obtained by a small sliding graft, which appeared to fulfil better the essential condition of wide exposure of raw bony surfaces.

The next case is similar, except that the first sliding graft failed to give union, probably because too small a fragment was used; whereas, when the operation was repeated and a large slice used, good union resulted.

Case 18.—Pte. C. (*Figs.* 188, 189.)

FIG. 188.—Pte. C. Ulna after intramedullary graft from tibia (false joint).

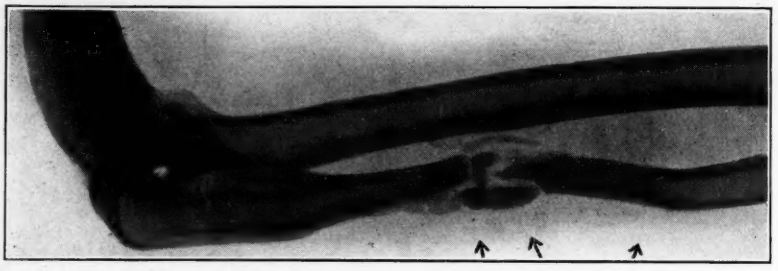


FIG. 189.—Same case as *Fig.* 188, after sliding graft, taken partly from surface of previous graft; good union.

July, 1916: Wounded. *Feb.*, 1917: Healed. *May*: Admitted, ununited fracture of ulna. *Sept.* 17: Sequestra removed and scar excised. *Nov.*: Intramedullary graft from tibia to ulna. *June*, 1918: Non-union between upper fragment and graft; small sliding graft from upper fragment placed across gap. *Feb.*, 1919: Union still weak. Long sliding graft from the upper fragment placed on deep surface of gap. *May*: Good union.

The following case, where the precaution of first excising the scar was omitted, had severe recurrences of sepsis, yet united by means of a sliding graft; probably a large tibial graft in such a case would have acted as a foreign body, and come away without giving union.

Case 19.—Pte. M.

Oct., 1918: Wounded. *Nov.*: Admitted. Ununited fracture of ulna. *Nov.*: Sequestra removed, and bones refreshed and tied together with catgut. *Sept.*, 1919: Sliding graft. No preliminary excision of scar. Slight suppuration. *Jan.*, 1920: Small sequestrum removed. *Sept.*: Firm union.

The following case is another in which the sepsis was very persistent, the precaution of excision of the scar having also been omitted; intramedullary grafting and wiring both failed, while a sliding graft ultimately succeeded, although the sepsis was not yet quiescent.

Case 20.—Pte. H., age 24.
Aug., 1917 : Wounded. *Aug.*, 1918 : Healed. *May* : Admitted, ununited fracture of radius, mal-union of ulna. *June* : Sequestra removed from radius. *Jan.*, 1919 : Ulna shortened by 1½ in., ends tied with wire. *June* : Wire removed, non-union. *Oct.* : Sliding graft of radius. Suppuration. *March*, 1920 : Good union.

The following case exhibited an interesting mal-union of the forearm bones, which was successfully dealt with by excision of the head of radius, to allow rotation, and sliding graft of ulna after correction of the deformity. It appeared from the history that

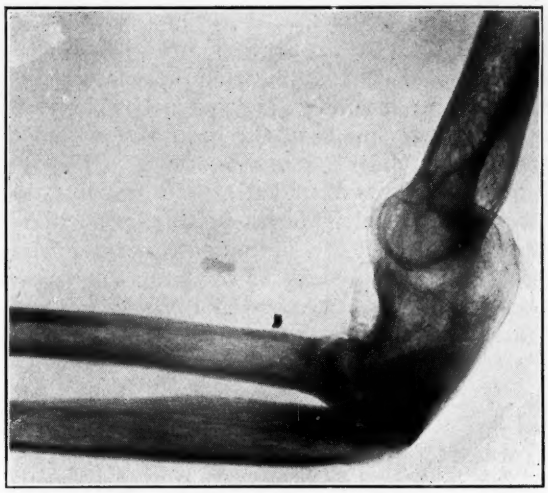


FIG. 190.—Pte. McK. Ankylosed elbow ; mal-union of radius and ulna after manipulation.

FIG. 191.—Same case as *Fig.* 190, after first operation. Excision of head of radius and stepping ulna.

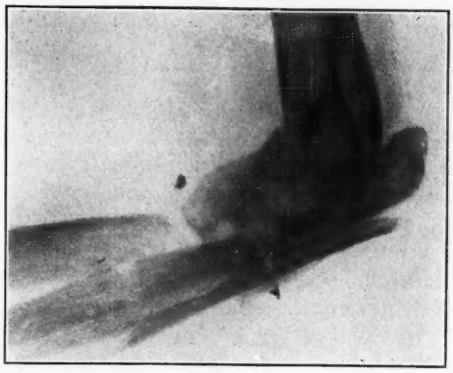


FIG. 192.—Same case as *Fig.* 190, after second operation. Sliding graft of ulna ; union, elbow in good functional position ; good rotation of forearm.

ankylosis of the elbow had occurred in the extended position, and that a surgeon had attempted manipulation under anæsthesia, which had resulted in flexion at the fracture of radius and ulna in upper third of the forearm, which also remained fixed in supination. This deformity interfered with the pull of all the forearm muscles, which rapidly improved after it had been corrected, so that it would not have been wise merely to correct the supination, as some surgeons who saw the case advised. This case also illustrates the danger of keeping compound fractures of the forearm long in the straight position. The Thomas splint is excellent for immediate application, to allow drainage ; but as soon as the sepsis is subsiding the elbow should be flexed, if necessary under anæsthesia, and usually the limb can be satisfactorily fixed in plaster, with windows for the wounds. If the manipulation is done at an early date, and the precaution taken of splinting the fracture with gutter-splints before it is begun, the joint will yield rather than the fracture ; if it does not, it is best left for open operation after the fracture has united.

Case 21.—Pte. McK., age 29. (*Figs.* 190, 191, 192.)
April, 1918 : Wounded. *Feb.*, 1919 : Healed. *March* : Admitted. Fracture of radius and ulna in upper third of forearm united at right angles. *July* : Removal of head of radius, wedge

removed from site of ulnar fracture, ends of bone stepped and tied with kangaroo tendon; muscle placed between the radius and other bones. *Oct.*: Weak union of ulna with ankylosis of elbow. Sliding graft of ulna. Humerus and ulna separated through open incision. Good union of ulna followed, but the upper part of graft was extruded. Elbow movements remained limited, but rotation of forearm was good.

The following case represents the course and treatment of an uncomplicated sliding graft of the tibia. These cases are among the simplest and most satisfactory with which we have to deal, and it is unnecessary to record more than one in detail. The difficulties which may be encountered are: firstly, backward bowing, which is most safely corrected by a preliminary operation, with excision of scar tissue and the application of plaster in the corrected position; secondly, lack of active bone when the upper fragment consists of the head of the tibia only, so that the upper end of the graft is apt to lie loose in a cavity and become surrounded by clot which, when it organizes, will produce a fibrous union; in such a case it is best to supplement the sliding graft by one from the other tibia, so that the cavity is obliterated by pieces of bone; thirdly, if the patient walks too early without support, he is apt to break the graft, and spontaneous union is rare after such an accident.

FIG. 193.—Pte. T. After operation. Sliding graft of tibia; small fragment also placed in gap; good union of both.

Case 22.—Pte. T. (*Fig.* 193.)
July, 1918: Wounded. *Oct.*: Healed. *May*, 1919: Admitted, with gap fracture of tibia. *Aug.*: Sliding bone-graft of tibia. Plaster. Walked with plaster on until *Oct. Nov.*: Outside leg-iron fitted. Good result.

Method 4.—INTRAMEDULLARY GRAFTS.

The idea of the intramedullary graft is to fix the two fragments of bone in contact and in perfect alinement by means of a bone peg driven into each medullary cavity.

Ideal as this seems in theory, its practical application is by no means so simple. Firstly, it is often impossible to get the ends of the bone far enough apart to allow of the introduction of the peg into both fragments; this difficulty has been circumvented by some surgeons by putting the peg into the side of one fragment, which, however, is not certain to give the stability which is theoretically obtainable in the other way. The method of driving the graft in from one end of the bone, through the skin, while overcoming this drawback, has considerable technical difficulties.

Secondly, the medulla of the forearm bones has so small a bore that the part of the graft which enters it has not much strength and is apt to break, even if the part between the bone-ends is left thicker, like a cricket-bail.

Thirdly, the area of raw bone from which osteogenesis is to spread is less in this method than in those where a large area on the side of the bone is freshened; indeed, as shown by repeated *x*-ray examination, the very place whence the maximum of early callus is formed, the medulla, is corked up by this method.

The graft also plugs the most vascular part of the bone, from which new vessels should develop to nourish the graft, the clot from the open medulla being probably the source of these. Many *x*-rays of intramedullary grafts show a zone of rarefaction around the implanted end of the graft, similar to that which is apt to develop round a wire or plate, suggesting that it interferes with the nutrition of the neighbouring bone, and acts almost like a foreign body.

The intramedullary graft is useful in maintaining apposition of the ends of the humerus or femur, but it is safest to supplement it by a lateral graft.

The advocates of the intramedullary method have numerous excellent results to show in its support; nevertheless they have always a certain number also where a false joint has formed at one end, and these appear to be in the very cases where there is special strain on the graft, which is the complication that the intramedullary graft was designed to overcome. The upper third of the ulna, where the upper fragment tends to be deflected outwards and backwards, is a notable instance of this. The following cases illustrate the point. In the writer's experience there is less tendency to false-joint formation with the lateral grafts.

A considerable number of cases have been recorded above where intramedullary grafts failed to give union, and some other method had to be resorted to later. These have given the writer an unfavourable impression of the intramedullary method, especially as the operations were nearly all carried out by, or under the immediate supervision of, surgeons who had considerable experience of the method in civilian surgery before the war.

The cases already referred to are: Pte. McG., *Case* 6; Pte. C., *Case* 18; Dvr. H., *Case* 17.

One case already described gave an excellent result, but in it the grafted bone was healthy, i.e., the ulna, when the forearm was being shortened: Pte. N., *Case* 5.

Method 5.—INLAY GRAFTS.

Inlay bone-grafts form, in the writer's experience, the most satisfactory method of dealing with an ununited fracture, where any considerable deficiency of bone exists.

In its original form, as described by Albee, the inlay graft was fitted with the accuracy of a cabinet-maker into its bed, which, though a simple process in theory, is by no means so when applied to actual bones with their natural irregularity, besides that acquired through the trauma. However, as we are not dealing with inert wood, where mechanical stability is of primary importance, but with living bone, which can and will modify its structure in accordance with outside conditions, other considerations are of more importance. Thus, the most accurate carpentry will not provide a union strong enough for satisfactory function if the blood-supply is deficient or the osteoblasts are so inactive that they do not weld the graft and host into one living whole; indeed, many grafts which give excellent *x*-ray appearances immediately after operation are found to absorb or break in course of time. On the other hand, a graft which only fits roughly into its bed, but is thick enough to stand the initial strain and consists of vascular active bone in a similar bed, will unite rapidly and firmly, while ultimately the lines of stress will modify the form of the new bone, so that an approximation to the normal type is attained. In other words, the essentials are: (1) That the graft be thick and vascular; (2) That it be applied to as large a raw area of the host as possible; (3) That the maximum area of cancellous bone be exposed, consistent with stability; (4) That the junctions of the graft with host be protected from all strain until callus unites them (usually four to six weeks), and then be subjected to small degrees of strain, such as muscular contractions against resistance (i.e., without movement), whereby the new bone is stimulated to grow and to harden.

These conditions can usually be attained by the use of grafts cut from the subcutaneous surface of the tibia, with its periosteum, which ensures the retention of the surface osteoblasts; the graft is applied to slots which have been cut on corresponding surfaces of the two fractured ends; the graft is held by ligatures of iodine-tannic catgut, which prevent displacement while a plaster cast is being applied. The plaster is worn for about four weeks, being merely split on one aspect if the limb should swell unduly; then it is valved for removal of the stitches and massage, and is retained for about another four weeks, or to whatever period is required for firm union. Periodic *x*-ray examination of cases with non-union suggests that early and excessive strain on the graft is, next to sepsis, the commonest cause of failure.

The following case records, with their skiagrams, show what satisfactory results can be obtained by a technique which is absolutely simple. The only special experience which it requires is in the use of the electric saw and in the application of plaster. A cast applied at the operation must be applied very evenly and over a thick layer of wool, which must also be evenly distributed; this precaution usually compensates for any swelling that may occur; in certain cases there may still be excessive swelling, but if the cast is split down the whole length (not merely a portion) of one aspect, i.e., the one where strain is least, then the œdema will rapidly subside and there will be no tendency to deformity. In the upper limb, if the digits are carefully left free so that the act of closing the fist can be carried out, this will provide a degree of function which stimulates bone-growth without straining the graft. In the lower limb, a cast which fits well enough to allow walking attains the same end. The writer has found the application of a plaster metatarsal bar very effective in preventing weakening of the footpiece of the cast with the consequent tendency to equinus. Even if the patient is foolish enough to walk out in the damp with the cast, a thick metatarsal bar will usually hold the foot firm.

The fact that the graft can act as a source of new bone seems proved beyond possibility of error by the following case, in which a wide gap in the ulna had been bridged by a piece of tibia, and good union had occurred at the ends of the graft; then the patient snapped the graft in its centre, far from the original ends of the ulna, yet union occurred within a few weeks by ensheathing and central callus. It does not appear from the *x* rays that the fresh callus could have had any other source than the graft, as the latter had not been in place long enough to have been reconstructed *in situ*, as most grafts seem to be ultimately.

Case 23.—Pnsr. R. (*Fig.* 194.)
Dec., 1918: Kicked by horse. *May*, 1919: Ulna plated. *Feb.*, 1920: Admitted. Ununited fracture of ulna, screws having become loose. Man could not lift a weight. *Feb.*: Sliding graft of ulna, after removal of plate. *June*: Non-union. Tibial inlay graft. Bone-ends trimmed until

FIG. 194.—Pnsr. R. Graft uniting spontaneously by lateral and central callus.

a 2-in. gap was left, deep aspect of each fragment rawed for 1½ in. Five-inch tibial graft tied in place with catgut. *Jan.*, 1921: Returned with fracture of graft in its centre, the result of heavy work. Ends well united. Plaster applied for three weeks, after which callus union occurred on the deep surface of the graft, away from the ulna. Firm union after nine weeks.

The following case illustrates the value of a strong tibial graft as a source of bone in one of the most disabling injuries with which the orthopædic surgeon has to deal, i.e., a flail shoulder in which about the upper half of the humerus has disappeared. In the case quoted, if an attempt had been made to fix the upper end of the shaft in the remains of the glenoid, the limb would have been shortened beyond use; moreover, it is unlikely that any form of ankylosis could have been attained, with so much strain on the union. Here a tibial graft resulted in a fibrous ankylosis without excessive shortening, and such as restored useful function to the limb, even though far short of the normal.

Case 24.—Sgt. McC., age 22. (*Figs.* 195, 196, 197.)
Nov., 1916: Wounded left shoulder, bone freely removed. *May*, 1917: Healed. *July*: Admitted. Flail shoulder, with about 4 in. missing from upper end of humerus. *July*: Graft from tibia, 3½ in. long, driven into humerus. Arm in abduction splint. *Aug.*: Upper end of graft had slipped out of glenoid; replaced, arm and chest put up in plaster. *May*, 1918: Good function; can lift arm to occiput and carry moderate weights.

FIG. 195.—Sgt. McC. Flail shoulder; loss of 4 inches from upper end of humerus.

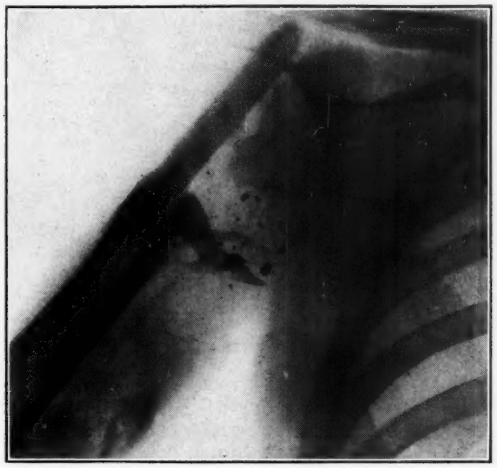


FIG. 196.—Same case as *Fig.* 195, after operation. Bone-graft from tibia (slipped out of glenoid).

FIG. 197.—Same case as *Fig.* 195, one year after operation: shoulder stable; graft much thicker; much new bone formed.

The following two cases illustrate the course of uncomplicated forearm fractures treated by inlay grafts from the tibia.

Case 25.—Pnsr. M., age 22. (*Fig.* 198.)
Oct., 1918: Wounded. *Feb.*, 1919: Healed. *May*, 1920: Admitted. Non-union of ulna just above the middle; ulnar deviation of hand and inability to lift. *Sept.*: Inlay tibial graft, 5 in. long, applied to the deep surface of ulnar fragments. Four months later union firm and function good.

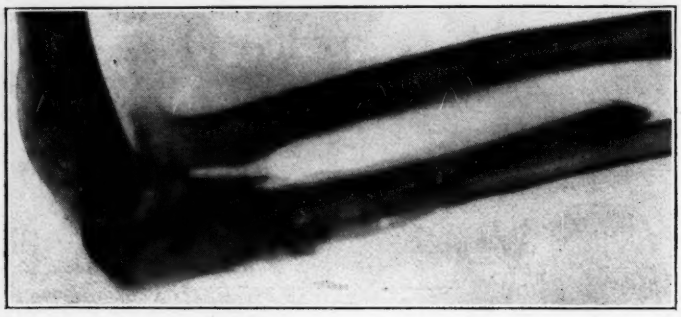


FIG. 198.—Pnsr. M. Lateral graft from tibia to ulna; firm union.

Case 26.—Pte. S., age 22.
July, 1916: Wounded. *Feb.*, 1917: Healed. *Jan.*, 1917: Admitted with gap in middle of radius. *March*: Bone-graft from tibia to radius 4 in. long, tied to deep surface of radius by fine wire. Wound broke down several times. *Dec.*, 1918: Wound healed finally. *March*, 1918: Firm union, good function.

In this latter case, it is likely that the wire helped to keep alive the sepsis and induced the bone necrosis noted above. It is astonishing that the flares were so mild, considering the short period for which wounds had been healed before the operation. This was one of the earliest cases done at Bangour, before the prophylactic and diagnostic value of heavy massage had been realized and become a routine.

In the space at our disposal it is impossible to give in detail all the cases which are instructive, but it is hoped that the study of those recorded above may impress on the reader the common difficulties and sources of error. They have been chosen among the ones which presented difficult problems, or in which some procedure, commonly recommended, had failed, either from its being unsuitable to the type of case, or from errors in the execution. While some of them are depressing reading, as records of repeated failure, yet they show that in almost all cases success can ultimately be attained, if the patient and surgeon both possess patience and determination.

Method 6.—PLATING.

Of the use of plates the writer cannot speak from personal experience. A certain number of failures after this method have come for further treatment, and union has been attained by the methods described above. Although all methods result in some failures, the following considerations appear to the writer to weigh seriously against the use of metal plates:—

1. After gunshot injuries there is the ever-present fear of a recrudescence of sepsis, and this risk is increased by the presence in the tissues of a foreign material, such as a plate; if a flare-up should occur, it will not subside till the metal is removed, which probably entails a second operation; whereas a certain number of bone-grafts unite even in the presence of sepsis; and if they do not, the dead bone tends to break up and come away spontaneously without much delay.

2. Metal tends to cause an area of rarefaction in the bone immediately surrounding it, which is well shown by *x* rays, so that screws are apt to become loose, and the very mechanical stability, which was the chief recommendation of the metal, is annihilated.

This effect is most marked in the presence of strain, i.e., in the very cases where other methods are difficult.

3. Non-union is usually associated with sclerosis of the bone at the site of fracture, and mere fixation of such avascular ends is usually insufficient to induce the formation of sufficient callus. When a vascular graft is applied and the atrophic bone trimmed away, then absolute fixation is found to be unnecessary; indeed, a wire or plate is apt to interfere with the vitality of the graft.

4. Even when plates are used, it is usually necessary to supply some outside support also; whereas, when plaster is applied, the temporary fixation of catgut is enough to prevent slipping while the cast is being put on, so that the strength of the metal is no advantage, while, as noted above, it does not always retain a good hold after the month at the end of which the plaster is removed.

Method 7.—GRAFTS OF IVORY OR BOILED BONE.

Of heterogenous grafts and those of ivory or dead bone the writer has no personal experience. Many of the arguments used against metal apply to them, and as there is always in the patient's tibiæ and iliac crests a supply of living bone of various types, it is difficult to see the indication for these extraneous materials.

One final point is worthy of careful attention, i.e., that in cases of non-union after gunshot injuries the condition of the bone is only one factor in the patients' disability, not always the most important one. Usually several muscles have been shot away with the bone which leaves the gap; often a nerve is cut or compressed; more often still the severe sepsis which may have helped to prevent bony union has left tough adhesions in or around the joints. If these conditions are not treated adequately, the most perfect bone operation will merely have put the patient to much inconvenience and some suffering without improving the function of the limb. For instance, non-union of the radius in the lower third is nearly always accompanied by loss of the extensors of the thumb, and without them the thumb is almost useless, and accordingly the whole limb almost functionless; in the upper-third fractures it is the posterior interosseous nerve which has suffered, and unless its muscles are restored by some form of tendon-transplant, the hand is valueless. Similarly, severe fractures of the tibia are apt to interfere with the tibialis anticus, one of the most important muscles of the lower limb. These remarks may seem unnecessary, as the logic of the matter is obvious on paper; but it is extraordinary how often this aspect of a case is overlooked in practice, unless a routine of examination for the joints, muscles, nerves, and blood-vessels is carried out in every case of injury to a limb.

EPONYMS.

II.—'BAKER'S CYSTS', AND BAKER'S TRACHEOTOMY TUBES.

Mr. Morrant Baker's paper "On the Formation of Synovial Cysts in the Leg in Connection with Disease of the Knee-joint" lies buried in the thirteenth volume of the *St. Bartholomew's Hospital Reports*, 1877, pp. 245–261, "the family mausoleum" as the Reports were once wittily called by Sir Thomas Smith, the editor, looking to the close body from which they emanated and the very limited circulation they attained.

Mr. Baker states that his "attention was first drawn to the diseased condition which forms the subject of the present paper by the following case which was under the care at different times of my colleagues, Mr. Callender and Mr. Marsh, and of myself.

"For the notes of the case I am indebted to the Records of the Surgical Registrar, Mr. Butlin.

"LARGE CYST IN THE CALF OF THE LEG—OSTEO-ARTHRITIS OF KNEE-JOINT—AMPUTATION.

"A woman (M. S.), 38 years old, was admitted into St. Bartholomew's Hospital, under the care of Mr. Howard Marsh, July 22, 1873, with a large swelling in the calf of the right leg. The right leg was about twice as large as the left, from just above the knee to the ankle. There was slight œdema, and the superficial veins looked tortuous and dilated. There was no great pain or tenderness, and no hardness or swelling could be felt in the track of the popliteal vein. The swelling was generally uniform, but especially marked in the calf, where deep-seated fluctuation could be felt. A slight pulsation was also perceptible, but was apparently only transmitted. There was also some effusion in the knee-joint. The patient was thin, but otherwise in fair health, and complained only of numbness and very slight pain in the leg.

"The history given by the patient was that five months ago the right leg began to swell, and had continued since slowly increasing. She thinks that, as she stooped one day, something cracked in the knee, and from that time it began to swell. She has had swelling of the leg after each confinement.

"At a consultation which was held on the case, it was generally agreed that there was a quantity of fluid, perhaps pus, beneath the superficial calf-muscles, with probably thrombosis of the deep veins.

"A day or two after the patient's admission to the Hospital, the swelling in the calf was punctured by Mr. Marsh with a very fine trocar, and several ounces of fluid were drawn off, leaving behind a considerable amount of thickening. Much to the surprise of those present, the fluid was not purulent, but apparently cystic. It was translucent, pale red, viscid, slightly turbid, and alkaline. It contained a large amount of chlorides, and was almost solidified by heat and nitric acid. Microscopic examination failed to detect more than the presence of blood-corpuscles; there were no pus-cells.

"*July* 28.—The fluid has apparently collected again. The measurement of the right calf is 13⅝ in.; that of the left, 9⅝ in. There is no enlargement of the femoral or inguinal glands. The swelling and thickening of the leg seems to be chiefly in the upper part of

the gastrocnemius, especially in front of the muscle, and in its external head, and between the two heads as well as some three or four inches lower. The swelling below the calf is probably only œdema, on account of the pressure above.

" *July* 31.—The swelling in the lower part of the leg is much diminished.

" Since her admission the patient has been unable to retain either urine or fæces, which all pass involuntarily. This has been so, it is said, for some time past. An examination of the vagina and rectum, however, has discovered no abnormal condition, and throws no light on the condition of the leg.

" *Aug.* 4.—The leg is generally much smaller and less painful. Measurement of the calf is 12 in. The condition of the knee is not changed.

" *Aug.* 16.—The thickening in the upper part of the calf is much less. The knee is bandaged.

" *Sept.* 5.—There is still some thickening in the upper part of the calf. The knee, in spite of careful and constant bandaging, is gradually increasing, apparently on account of the fluid in the joint. The leg is now abducted and slightly everted.

" *Sept.* 17.—The thickening in the upper part of the calf is apparently permanent, but not manifestly increasing. The knee is still enlarging. The patella is now much displaced outwards, the leg is still more abducted, and the foot everted. It seems as if there were some enlargement of the upper end of the tibia or the lower end of the femur. Measurement around the knee is 15½ in., and around the lower end of the femur 16 in.

" Soon after the last note the patient left the Hospital, but was re-admitted in August, 1874, under the care of Mr. Callender, on account of the condition of her knee-joint. In his absence she was for a time under my care, and I had many opportunities of observing the state of her limb.

" Since she had left the Hospital, the swelling of the knee had to a great extent subsided. About two months, however, before her re-admission she fell down, and from that time the leg has been 'out of place', and dangling loose and useless. There has not been very much pain. At the time of her re-admission the right tibia was found dislocated outwards and backwards, and the leg hung loose and flail-like. It could be twisted easily in all directions, and even replaced in fair position, from which, however, it at once reverted to its mal-position when restraint was discontinued. The bones grated at the knee-joint, as if they had lost their cartilage. The synovial membrane was not now very much thickened, and there was no pain or tenderness, even on free movement.

" The whole of the extremity was atrophied. No trace of the cystic disease of the calf, or even of thickening in this part, could be detected.

" Attempts were made to improve the position of the dislocated bones, and to give such mechanical support as would enable the limb to be used, but without success, and amputation of the thigh was performed by Mr. Callender in January, 1875.

" Examination of the Limb after Removal.—The joint-surfaces were found in great part denuded of cartilage, smooth and eburnated, having nodules of bone growing out from their edges. Portions of the cartilage remaining were soft, vascular, and pulpy. The ligaments had been almost wholly destroyed. The synovial membrane was thickened, many of its processes standing out on its interior like small firm fibrinous nodules. A considerable quantity of viscid fluid was in the joint.

" No trace of the cyst in the calf could be discovered.

" On thinking over this case, it seemed to me more than probable that the supposed cyst in the calf of the leg was formed really by a collection of fluid which had escaped from the interior of the knee-joint. The character of the fluid, the progress of the case as it developed, and the total disappearance of the cyst—so that even on examination of the limb after removal no trace of it could be discovered—all seemed to favour this view of its nature."

Details of seven other cases are given, and Mr. Baker then proceeds to discuss the route which is taken by the fluid when making its way out of the knee-joint to form an artificial synovial cyst in the neighbouring tissues.

The paper ends with: "The following are the conclusions deducible from the foregoing cases:—

"1. That in cases of effusion into the knee-joint, and especially in those in which the primary disease is osteo-arthritis, the fluid secreted may make its way out of the joint, and form by distention of neighbouring parts a synovial cyst of large or small size.

"2. That the synovial cyst so produced may occupy (*a*) the popliteal space and upper part of the calf of the leg, or may (*b*) be evident in the calf of the leg only, projecting most, as a rule, on the inner aspect of the leg, or (*c*) may be perceptible only at the upper and inner part of the leg as a small defined swelling, not approaching within three or four inches of any part of the knee-joint.

"3. That, however large the synovial cyst may be, fluctuation may not be communicable from it to the interior of the knee-joint; but the absence of such fluctuation must not be taken to contra-indicate the existence of a connection between the joint and the cyst.

"4. That the synovial cyst may be expected to disappear after a longer or shorter period, without leaving traces of its existence, even on dissection of the limb.

"5. That the cyst should not be punctured or otherwise subjected to operation, unless there appear strong reasons for so doing; inasmuch as interference may lead to acute inflammation and suppuration of the knee-joint.

"6. That most often the disease in the knee-joint will be found to have begun some time before the appearance of the secondary synovial cyst; but sometimes the patient's attention may be first drawn to the latter, or the cyst may seem for a long period the more important part of the disease."

It is interesting to note how this opinion is borne out. The case on which these observations is founded presents all the characters of a tabetic arthropathy, a condition but little known to surgeons in 1877, though it had been described by Charcot, Clifford Allbutt, and other physicians.

The series of synovial cysts in connection with joints was enlarged, and the pathology was placed upon a more sound footing, by contributions to the Pathological Society of London in 1885 and 1887.

BAKER'S RUBBER TRACHEOTOMY TUBES.

Mr. Morrant Baker read a paper before the Royal Medical and Chirurgical Society on November 28, 1876, entitled "On the Use of Flexible Tracheotomy Tubes". The paper is published in *The Medico-Chirurgical Transactions*, 1877, lx, 71–84. He says:—

"It had long occurred to me that an elastic tracheotomy tube might be constructed which would answer all the purposes of the rigid cannula, and at the same time be free from its disadvantages; but it was only last year that my idea was brought into working shape by my friend Mr. Paley, House Surgeon to the Evelina Hospital, to whom I am indebted for taking much trouble in superintending the construction of an indiarubber tube, made by Mr. Millikin, of St. Thomas's Street. The tube was made of ordinary indiarubber, and answered the purpose for which it was intended very fairly; but it was evident that a better material would be preferable, and the cannulæ have been since constructed of vulcanized red rubber, a material which is in a high degree elastic, tough, and durable, and remains almost unaltered after long soaking in pus or other like fluids.

"The shape of the cannula is that of the ordinary silver tracheotomy tube. There is no laryngeal opening, but this can be made at any moment, with a sharp knife or scissors, at the part of the tube which seems best for the case in which it is being used. The tube is single, and it has been found hitherto so easy of introduction and withdrawal, or, in other words, one tube can be so easily replaced by another, that I have not thought it necessary to devise a combination of inner and outer tubes, as in the case of the silver cannulæ commonly in use."

Mr. Baker then proceeds to point out the advantages and disadvantages attending the use of such a tube, and gives notes of cases in which it had been employed, including one from Mr. H. H. Clutton, who was then acting as resident assistant surgeon at St. Thomas's Hospital.

William Morrant Baker, the son of a solicitor, was born at Andover in 1839, and was assistant surgeon and surgeon to St. Bartholomew's Hospital from 1871 to 1892. He lectured on physiology in the medical school, and edited the 6th to the 13th editions of Kirke's *Physiology*, a popular text-book on physiology which was subsequently issued under the supervision of Professor Halliburton. Baker introduced the practice of removing the tongue in two halves, an operation which he usually performed by splitting the organ longitudinally and then removing each half with an *écraseur*. His ingenuity is shown by the fact that as early as 1860 he had invented a reading lamp with a metal bar of about a quarter of an inch in width in the long axis of the flame immediately above the burner. The flame being thus divided, there was a more perfect combustion of oil, with a considerable increase in its illuminating power. The principle afterwards became universally recognized as the 'duplex burner'. He died after a long illness on Oct. 3, 1896.

CHRONIC DUODENAL ILEUS.

By D. P. D. WILKIE, Edinburgh.

The condition known as acute gastromesenteric ileus or acute arteriomesenteric ileus is now a well-recognized entity. Whilst all cases of acute post-operative dilatation of the stomach may not be dependent on pressure on the third part of the duodenum by the superior mesenteric vessels, it is clearly established from a large number of operative and post-mortem observations that compression of this part of the duodenum is the common cause of the acute duodenal and gastric dilatation. It is also proved that treatment based on this view of the pathology of the condition is almost uniformly successful if resorted to promptly and thoroughly. The prone position with elevation of the pelvis, in conjunction with the use of the stomach tube, has rendered a formerly grave and usually fatal complication an eminently curable one.

Whilst examining the duodenum in several hundred cases in the post-mortem room, I was struck by the presence in a certain relatively small proportion of them of what appeared to have been a chronic dilatation of the first three parts of the duodenum up to the mesenteric vessels. A study of the histories of these cases threw practically no light on the duodenal condition. Most of them had died from disease outside the alimentary system, and, except for a note of digestive disturbance, no record of any significant symptoms could be found.

Experimental work on closed duodenal loops had shown me how toxic retained duodenal content may be and how critical a region of the digestive tract the duodenum unquestionably is. When, in addition, one considered how rapidly fatal an untreated acute gastromesenteric ileus is, the very natural and pertinent questions arose: (1) *Does a chronic obstruction of the duodenum from mesenteric compression never occur?* (2) *If it does occur, does it give rise to no recognizable clinical picture?* (3) *May it not be the precursor of the acute post-operative condition?*

All who have interested themselves in this subject are familiar with the records of cases of fatal acute dilatation of the stomach occurring independent of any operative procedure under general anæsthesia: cases, for example, arising after fractures requiring treatment in the recumbent posture, and cases where the condition apparently set in spontaneously without any operation or accident. The link in the chain of evidence which one desired, however, was the case where the full-blown acute and fatal condition followed on a previous chronic gastro-intestinal picture.

Some two and a half years ago, an important link in the chain of evidence was furnished by the following case of a patient who came under my care in the Royal Infirmary, Edinburgh:—

Case 1.—Female, age 63: admitted to hospital with the diagnosis of 'acute intestinal obstruction'. The patient was so ill that a detailed history could not be obtained, and, as she lived by herself and had no intimate friends, the following facts were all that could be obtained. For years she had been troubled with her stomach and suffered from chronic constipation. For the past three weeks the trouble had been aggravated, and she had vomited daily and had kept no food down. For the past week, vomiting had been constant, day and night, and for four days there had been no action of the bowels or passage of flatus, in spite of enemata. The vomit had been for the most part green and bilious; latterly, however, it had been darker in colour.

On Examination.—Patient looked very ill, with sunken eyes, dry tongue, a subnormal temperature, and a small thready pulse, rate 140. She was emaciated. The abdomen was tumid and tense; on palpation, splashing was readily elicited in the umbilical and hypogastric regions. No tumour was palpable anywhere. Immediate operation was undertaken.

Operation.—The abdomen was opened in the mid-line in the umbilical region. An enormously

distended stomach was found filling almost the whole abdomen. A stomach tube was passed and 8½ pints of dark bilious fluid were drawn off. As the stomach receded it was seen that the duodenum was greatly dilated in its first two parts, and, on lifting up the transverse colon, the third part of the duodenum was seen bulging forwards, greatly dilated, and distended up to the point at which it was crossed by the mesenteric vessels. Beyond this, the intestine was collapsed. On pulling up the loops of small intestine, which were all lying in the pelvis, they were seen to be empty, but congested, and to be studded with small ecchymoses. (The cause of the latter was found to be pressure on the superior mesenteric vein by the greatly dilated third part of the duodenum, which

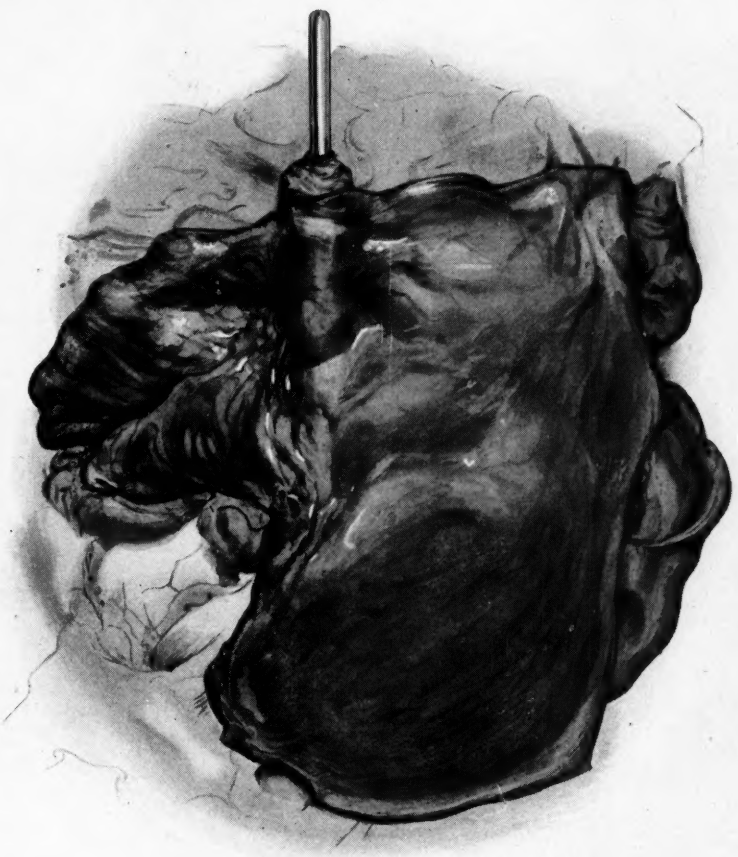


FIG. 199.—Third part of duodenum opened and viewed from behind. Stilette in superior mesenteric artery. Note great dilatation proximal to vessel, normal calibre beyond it.

had bulged over the accompanying vessels, and also almost certainly to pressure from the great weight of the dilated stomach.) A posterior gastro-enterostomy was performed. In spite of the administration of large quantities of saline intraperitoneally and subcutaneously, the patient never rallied, and died twelve hours after the operation.

POST-MORTEM.—The operative findings were confirmed. The great dilatation of the duodenum was found to end abruptly at the crossing of the superior mesenteric artery (*Fig.* 199). There was no evidence of any acute infective process anywhere which might have caused an acute toxic dilatation of the stomach.

The foregoing case settled in my mind quite definitely the question as to whether the condition of chronic duodenal obstruction occurred and was of clinical importance. The next bit of evidence was furnished by the case of a man who died with unusual rapidity after the perforation of a chronic duodenal ulcer. The following brief notes of his case are given :—

Case 2.—Male, age 37. Had suffered for some nine months from indigestion. For three days before the onset of perforation he had been out of sorts and said to be suffering from gastric

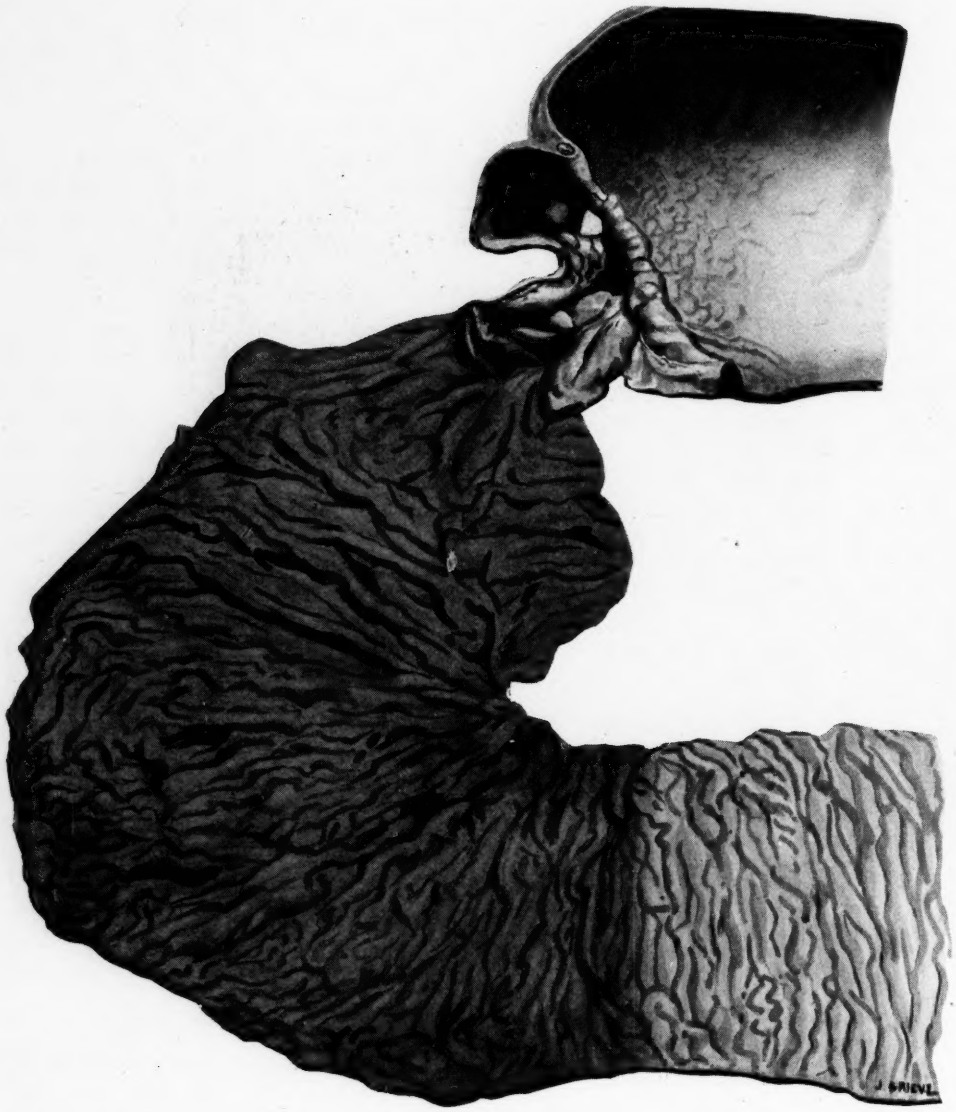


FIG. 200.—Duodenal obstruction associated with perforated duodenal ulcer. Note dilated and congested duodenum up to level of root of mesentery.

catarrh. At midnight on April 2, 1920, whilst in bed, he was suddenly seized with very severe abdominal pain. When seen by the doctor at 7 a.m., he was found in a state of collapse and was sent to hospital. On admission, at 11 a.m., patient was in a state of intense shock and was obviously moribund. He could not stand a general anæsthetic, but, under local anæsthesia, an attempt was

made to close the perforation. On opening the abdomen a very great quantity of bile-stained exudate escaped. He died on the table, however, within twelve hours of the original perforation.

The question arose as to why this well-developed man should have succumbed so quickly to a perforation of no great size, coming on, as it did, whilst he was on low diet and under treatment for so-called gastric catarrh.

POST-MORTEM.—The first, second, and third parts of the duodenum up to the root of the mesentery were very markedly dilated, the mucosa being intensely congested, in striking contrast to the pale mucosa beyond. No evidence of disease in other organs was found to account for the rapid collapse after the perforation.

In this case, it would appear that the rapid collapse and death were due to the sudden escape into the peritoneal cavity of a large quantity of retained and toxic duodenal

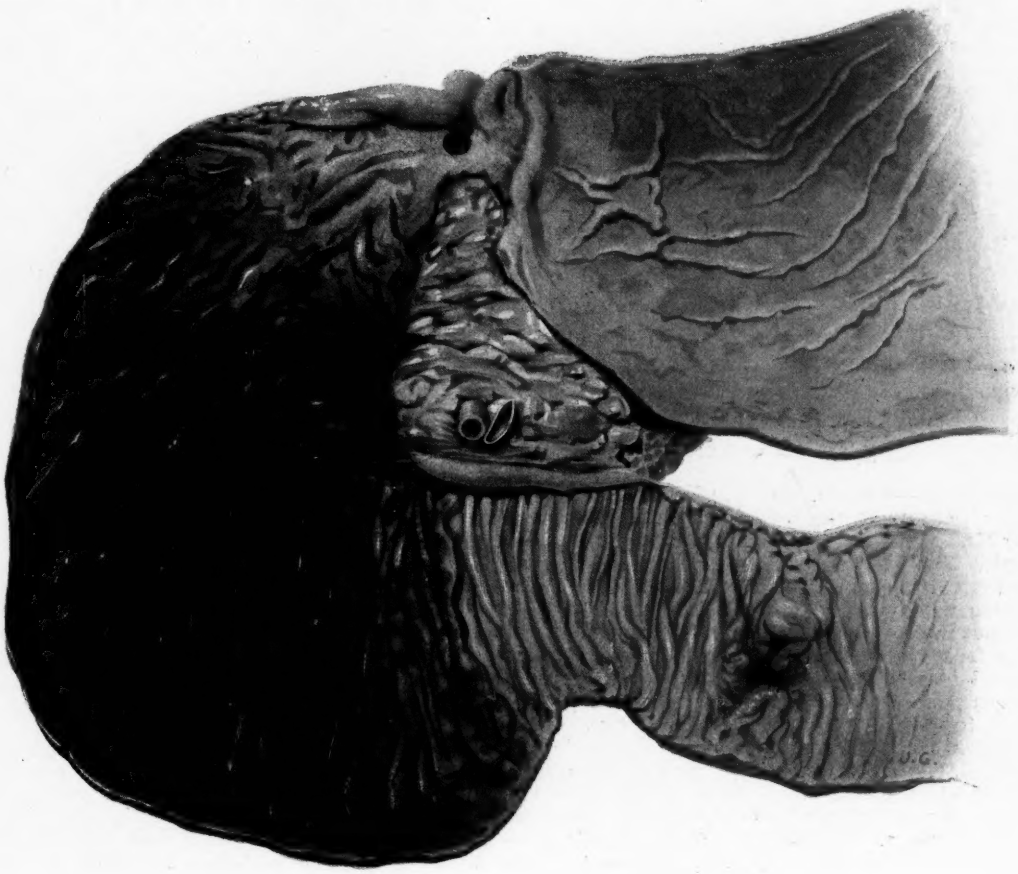


FIG. 201.—Duodenal obstruction causing vicious circle after gastro-enterostomy for duodenal ulcer. The opening in the jejunum was the lateral anastomosis described in *Case* 3.

contents from a dilated duodenum, the symptoms being almost anaphylactic in character and closely resembling those in animals with a closed duodenal loop.

The next piece of evidence was from the following case of death from 'vicious circle' after gastro-enterostomy :—

Case 3.—Mrs. J. B., age 44. Had complained of occasional stomach trouble since the age of 13, but had been in fair health until four months before operation. At this time she began to

suffer from severe pain in the epigastric region, coming on usually about two hours after food, frequently accompanied by vomiting, which always relieved the pain. She frequently suffered from great nausea, coming on at irregular times and followed by vomiting, which gave instant relief. Rest in bed and milk diet relieved her symptoms, but a return to more ordinary diet was followed by a recurrence of the pain, nausea, and flatulence. After treatment for ten weeks in a medical ward, a surgeon was called in. From the irregularity of the symptoms, and the fact that there was some tenderness in the right iliac and lumbar regions, it was thought that the gastric symptoms might be reflex from the appendix or proximal colon.

First Operation. Dec. 17, 1920.—Through a high gridiron incision, the appendix, which showed little abnormal, was removed, and a very mobile proximal colon was fixed after the method of Waugh.

Second Operation, Jan. 4, 1921.—Epigastric incision. A dilated and hypertrophied stomach and a duodenal ulcer causing definite stenosis just beyond the pylorus were exposed. A posterior gastro-enterostomy with a short loop was performed. The patient continued to vomit daily after the operation, for the most part bilious material.

Third Operation, Jan. 21, 1921.—The abdomen was re-opened in the epigastric region, and an entero-anastomosis between the two limbs of the loop was performed. It was noted that the proximal loop was not distended, as had been expected would be the case. After the third operation she continued to bring up mouthfuls of bilious fluid and gradually became more emaciated, refusing all food. In spite of absorbing large quantities of saline and dextrose per rectum she gradually sank, and died five days later.

Post-mortem.—A duodenal ulcer causing marked stenosis of the first part of the duodenum was found. Beyond this, the duodenum was greatly dilated up to the crossing of the superior mesenteric artery. The mucosa was engorged and congested. Beyond the root of the mesentery the bowel was pale and empty, and the entero-anastomosis was unavailing, as it was performed 2 in. beyond the seat of obstruction (*Fig.* 201).

This case again brought home to me how important a factor duodenal obstruction may be in causing death from regurgitant vomiting, and also how it may be associated with the presence of a very definite organic lesion in the first part of the duodenum.

The next case was the first in which I recognized the condition of chronic duodenal obstruction during life and treated it at operation. The history of the case is significant, as I believe it represents what is the typical picture of chronic duodenal obstruction from compression by the mesenteric vessels.

Case 4.—Female, age 38, married, six children. Complained of pain in the epigastrium after food; pain under the right breast, flatulence and vomiting.

History.—Ever since she was a young girl, patient has been bothered with flatulence after meals. Six years ago she had an attack of severe indigestion, accompanied by vomiting, lasting for several weeks. Two years ago she consulted her doctor for pains under the right breast, distention with wind after meals, and vomiting. Her doctor treated her for a sluggish liver, but without improvement. During the last two years she has never been free from pain and flatulence after food, and has always had to loosen her clothes after eating. During this time she has had several attacks consisting of, first, severe headache, blackness before the eyes; then a feeling of nausea and epigastric discomfort, followed by bilious vomiting, which gave her relief. She has lost 28 lb. in weight during the past two years. For many months her diet has consisted of milk, tea, and biscuits. If she took more solid food she had within an hour a sensation of distention sometimes almost amounting to bursting in the epigastrium, only relieved by vomiting. After one of the attacks from which she suffered, her friends remarked that she was yellow and hollow-eyed. When she vomited she brought up large quantities of fluid, usually, though not always, yellowish-green in colour. During the last two attacks of pain and vomiting she has had definite shivering.

On Examination.—The patient was thin and hollow-eyed. The abdomen was flat. There was definite tenderness under the right costal margin, and the upper part of the right rectus muscle was rigid.

Provisional Diagnosis.—"Gall-stone in common duct."

Operation, Feb. 11, 1920.—On opening the abdomen through the right rectus the gall-bladder was found to be normal in appearance and no gall-stones were present; the common duct was slightly dilated, but no stone could be felt. The stomach was distended with gas; the pylorus was widely dilated, admitting three fingers, and the first part of the duodenum was enormously dilated, resembling a second stomach (*Fig.* 202). The second half of the duodenum was likewise dilated. On throwing up the transverse colon, the third part of the duodenum, greatly dilated, bulged up into the wound. The dilatation extended to where the superior mesenteric vessels crossed the duodenum; beyond this the duodenum was collapsed and empty (*Fig.* 203). On passing a finger behind the mesenteric vessels, which were tightly stretched across the duodenum, and raising them, gas immediately escaped onwards into the jejunum.

The obvious treatment was to anastomose the dilated third part of the duodenum to the jejunum. The peritoneum of the posterior abdominal wall over the duodenum was incised, the

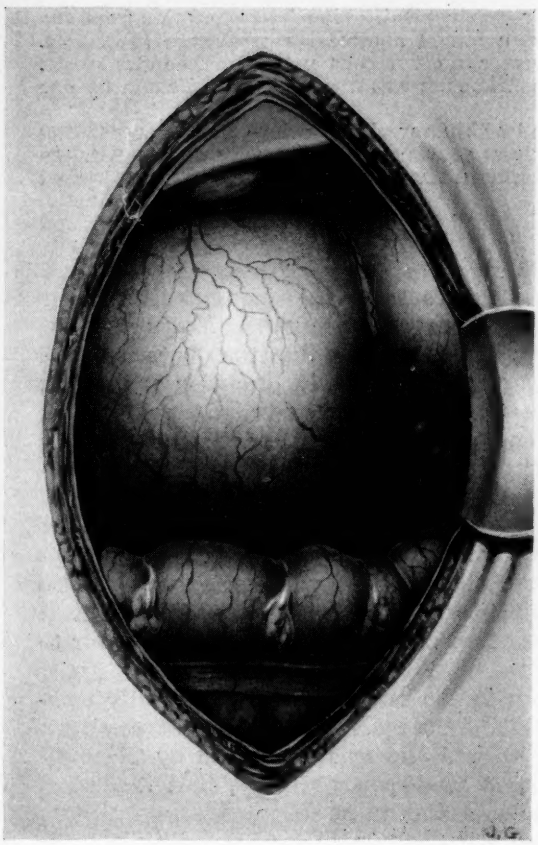


FIG. 202.—Great dilatation of first part of duodenum and pylorus as seen at operation in *Case* 4.

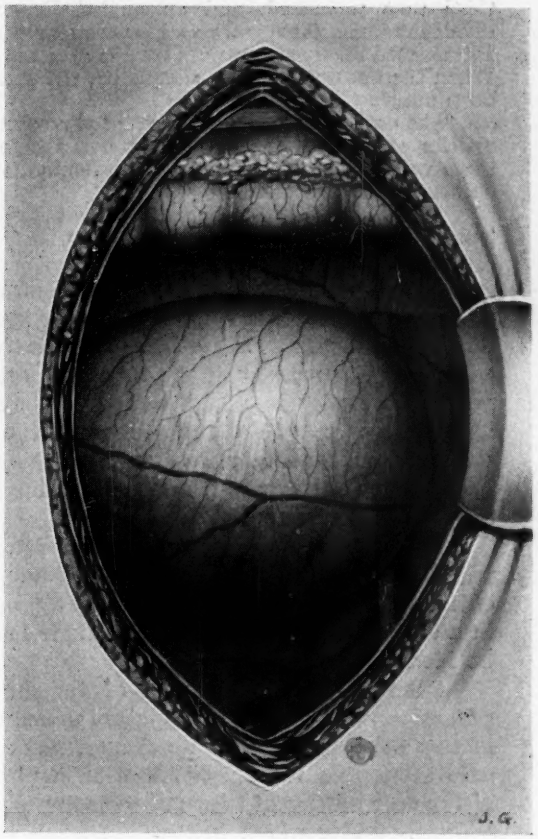


FIG. 203.—Distended third part of duodenum in *Case* 4, bulging into wound when transverse colon was thrown upwards.

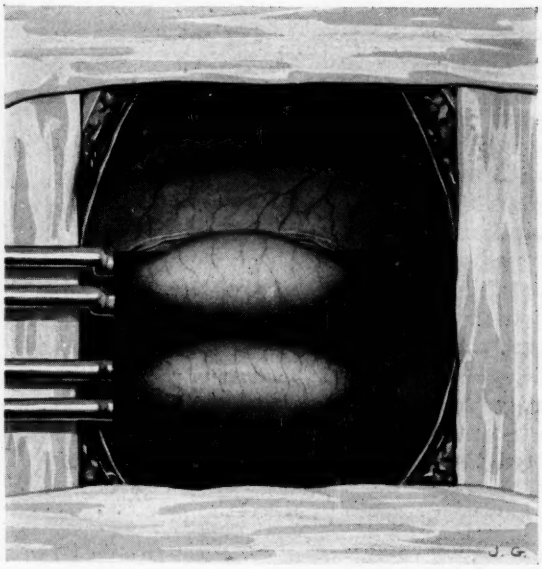


FIG. 204.—Clamps in position for duodenojejunostomy.

FIG. 205.—Completion of duodenojejunostomy; peritoneum fixed to duodenum by one linen suture.

third part mobilized, and an angled Brunner's clamp applied. The jejunum 7 in. from the duodenojejunal juncture was likewise clamped, and a lateral anastomosis performed (*Fig.* 204). Interrupted linen sutures were used for the outer layers, and continuous catgut for the inner layers. When the anastomosis was completed, the parietal peritoneum was fixed to the duodenum by one linen suture (*Fig.* 205).

The patient made an uninterrupted recovery, and within a week after the operation was taking articles of diet which she had not dared take for years previously. An *x*-ray photograph taken three weeks after the operation, two hours after a bismuth meal, showed that the duodenojejunal anastomosis was functioning well.

Ten weeks after the operation, the patient had gained 21 lb. in weight, and was feeling and looking very well.

This case was for me an epoch-making one, because of the clear-cut history, the unmistakable operative findings, and the striking improvement following drainage of the dilated duodenum. It was also most instructive in this respect, that the dilatation with gas which was present at the time of operation, and which made the condition so evident, pointed the way in which less pronounced cases might be demonstrated at operation, namely, by the artificial distention of the stomach with gas after the abdomen has been opened. Subsequently, I have found this practice of passing a stomach tube and distending the stomach during the operation an invaluable aid in distinguishing the presence of duodenal obstruction.

I have given the cases in some detail, because they represent the successive steps which led to the final recognition of what I take to be a definite pathological and clinical entity. Since then I have encountered and treated seven similar cases, and have found in a study of the literature that others have described and treated cases which appear to be identical.

Etiology.—The third part of the duodenum in the normal subject is slightly compressed and narrowed as it passes under the root of the mesentery. This is well shown in the wax casts of the duodenum made by Dwight,[1] and was recognized by Glénard,[2] who attributed to this constriction a physiological significance, namely, that it allowed of time for mixing of the food with the bile and pancreatic juice.

Any factor which lessens the angle between the superior mesenteric artery and the aorta and vertebral column through which the duodenum passes, will tend to cause a greater or less degree of duodenal obstruction. A congenital abnormality in the relationship of the vessel to the duodenum might thus lead to a partial obstruction which, late in life, might become more acute from the introduction of some other factor. If such congenital abnormalities occur, then we should expect to find occasionally an aggravated instance of the trouble in early life. This has been shown to arise, as in the cases of megaduodenum recorded by Dubose,[3] and by Downes,[4] where, in young children, enormous dilatation of the duodenum was found, up to the crossing of the mesentery, without any actual organic narrowing of the bowel being discoverable. In the cases met with in adult life, however, it is necessary to postulate some drag on the mesentery, which, acting intermittently, causes the 'attacks' from which the patient suffers.

Two conditions producing such a drag have been demonstrated. The one is where the empty small intestines hang over the pelvic brim without resting on the floor of the pelvis when the patient is upright or in the dorsal recumbent position, and where, from lack of tone in the abdominal wall, the natural support to the viscera is lost. When the empty small intestines hang over the pelvic brim, the mesentery is folded like a fan and the drag is a uniform one in the vertical direction. The other condition is that of congenital lack of fixation of the proximal colon, where the cæcum and ascending colon prolapse into the pelvis and exert traction on the mesentery in the line of the superior mesenteric artery. Bloodgood[5] has demonstrated this condition, and has treated it by resection of the proximal colon.

In one case presenting the symptoms of chronic duodenal obstruction in which the latter condition was present, I found that the pressure on the third part of the duodenum was exerted by the right colic artery, which crossed the duodenum in an almost vertical direction. This type of obstruction has, I find, also been noted by Grégoire,[6] by Villette,[7]

and by Duval,[8] in cases with a floating proximal colon. As might be expected, constipation frequently precedes the onset of the duodenal symptoms. Sclerosis of the root of the mesentery following on inflammation probably associated with mesenteriç glands may give rise to similar pressure on the duodenum. This appeared to be the active cause of obstruction in a case recorded by Grégoire. Personally I have not met with it. Air-swallowing may tend to aggravate the condition, and certainly did so in one of my cases. It is, however, a habit acquired from ineffectual attempts to relieve the flatulence by belching up wind, and has no primary etiological significance as Leveuf[9] would seem to indicate.

Pathological Anatomy.—The salient feature of the condition is the dilatation of the first three parts of the duodenum up to the crossing of the mesenteric vessels. The dilatation is most pronounced in the first part of the duodenum, which may look like a second stomach. The dilatation of this part may, however, be masked, or modified by the presence of the scar of a duodenal ulcer. In three of my cases a duodenal ulcer was present; in another, a gastric ulcer. The wall of the duodenum is hypertrophied, the degree varying in different cases. In one of my cases it resembled the wall of the stomach when grasped between the finger and thumb. The pylorus is usually dilated; in one case it admitted three fingers. This is not invariable, however, and the maintenance of the tonicity of the pylorus may modify the clinical picture, as will be indicated later.

The small intestines will, as a rule, be found empty and lying in the true pelvis. On drawing up the small intestines by pulling on the mesentery, a feeling of resistance is encountered and the intestines will sometimes leave the pelvis with a 'pop'. In other cases it is the cæcum and lower part of the ascending colon which occupy the true pelvis and offer resistance when an upward pull is applied to the mesentery. If the duodenum is distended at the time of examination, and a finger be passed behind the root of the mesentery and the latter lifted forwards, the duodenal content will immediately pass on and fill up the duodenojejunal loop.

Symptomatology.—The patient is usually a female of somewhat spare build and of the visceroptotic type. She gives a history of stomach trouble for many years, usually since childhood. She will state that she has always had to be careful of what she ate, otherwise she suffered from epigastric pain and flatulence. Periodically she has had 'bilious attacks', with nausea and vomiting. At the age of thirty or thereabouts the symptoms become aggravated. Epigastric discomfort and flatulence follow all but the simplest of meals. Walking and standing aggravate these symptoms; rest in bed gives a certain amount of relief. Some patients will volunteer that they have found that lying on the face or in the genu-pectoral position will give relief. In addition to the chronic flatulent dyspepsia so suggestive of a biliary condition, they suffer from what they term their 'attacks'. These are the typical popular 'bilious attacks' consisting of, first, a day of headache and nausea and epigastric discomfort, sometimes amounting to actual pain; this is followed by vomiting, first clear, then bilious. This may last for a whole day, after which the patient feels completely relieved, although relatives remark that she looks hollow-eyed and has a tinge of jaundice. Such attacks tend to recur at intervals of four to five weeks, and are ushered in by constipation. In a few cases the nausea, headache, lassitude, and epigastric pain are the most pronounced symptoms, and vomiting is an occasional and late symptom. In such cases it would appear that a tonic pylorus resists the duodenal tension until at last it gives way, bile regurgitates, is vomited, and relief is obtained. The persistence of such symptoms over a prolonged period is apt to lead to a state bordering on, if not actually of, neurasthenia, when the subjective symptoms complained of multiply by analysis and make diagnosis more difficult.

Physical Signs.—In a pronounced case, examination of the abdomen may reveal a definite epigastric fullness. This, however, will usually not be detectable. When asked to indicate the site where pain is felt, the patient will refer to a point about one inch above the umbilicus, and usually slightly to the left of the mid-line. At this area some superficial cutaneous hyperæsthesia may be detected. In some cases the seat of pain

is located to the right of the mid-line. Firm pressure by the examining hand from below upwards tends to relieve the pain. Should the duodenum be distended with gas at the time of examination, a definite tympanitic swelling may be made out above the colon. This I have seen in one case, but it must certainly be unusual. Succussion will show the stomach to be dilated. Duodenal succussion I have never elicited.

X-ray Examination.—The evidence of such examination is variable, for, whilst definite retention of bismuth in the duodenum, and particularly in the most dilated first portion, is obvious in some cases, on the other hand no such delay has been observed in cases which at operation showed unmistakable signs of duodenal obstruction with dilatation. Could the patients be subjected to *x*-ray examination during one of their 'attacks', one would doubtless obtain some more useful evidence. Marked ptosis of the cæcum and ascending colon may be shown by the rays, and may indicate the causal factor and the appropriate treatment.

Treatment.—As this condition is so often merely a complicating factor in visceroptosis, treatment by rest with the foot of the bed elevated, massage, feeding, and, later, an abdominal support, and suitable exercises, may reasonably be expected to relieve the earlier and less pronounced cases. For the severer cases, and those in which medical measures have failed to give relief, operative treatment must be considered. This will be of two types: it will be directed either to removing the drag on the mesentery, or to short-circuiting the obstruction. If, at the operation, the drag is obviously due to ptosis of an abnormally mobile cæcum and ascending colon, plication or fixation of these, or both measures combined, will be indicated and will give relief. In two cases which I have treated in this way the results have been quite satisfactory. Bloodgood, in five cases of this kind, resected the proximal colon with a successful result.

On the other hand, if the proximal colon is fixed and the drag is due to prolapsed small intestines or to some less obvious cause, or if the dilatation is so extreme as to have altered the relations of the third part of the duodenum, a short-circuiting operation is indicated and will undoubtedly give the most satisfactory result. The operation of duodeno-jejunostomy—making a lateral anastomosis between the third part of the duodenum and the first loop of jejunum—is both a safe and a satisfactory operation when the duodenum is dilated. With the transverse colon thrown upwards, the bulging third part of the duodenum rises into the wound. A transverse incision is made through the peritoneum covering it, and, by a little blunt dissection, the bowel is easily mobilized sufficiently to allow of an anastomosis clamp being applied. If a straight clamp cannot be satisfactorily used, a Brunner's angled clamp will prove useful (*Fig.* 204). The first loop of jejunum, about seven inches from the duodenojejunal flexure, is brought alongside and similarly clamped, and a lateral anastomosis performed. In all the five cases in which I have performed the operation, interrupted linen sutures for the outer row, and catgut for the inner rows, of sutures have been used. Linen was used for the outer layers because I was not sure of the healing properties of the duodenal wall in its retroperitoneal part. This, however, has proved so satisfactory that I should not now hesitate to use catgut throughout At the conclusion of the anastomosis the upper cut edge of the peritoneum is stitched to the duodenum with one or more sutures (*Fig.* 205).

After-treatment.—Sips of water by the mouth and rectal salines for the first forty-eight hours, after which a steadily increasing diet has been given in all cases. The post-operative course has been quite uneventful in all five cases; no vomiting and less discomfort than after most abdominal operations have been the rule. At the end of a week, all the patients have expressed themselves as feeling better than for years before, pain and discomfort having gone and appetite returned.

Consequences of Chronic Duodenal Ileus.—Stasis in the duodenum, besides leading to toxic phenomena, such as the headache, nausea, and malaise associated with a bilious attack, may, by allowing bacteria to multiply, be a source of infection to its own wall and to adjacent viscera which communicate with its lumen. The association of duodenal ulcer with chronic duodenal ileus is too frequent to be mere coincidence, and stasis in the duodenum must be registered as one of the predisposing causes of duodenal ulcer and as

a factor which may determine the gravity of a perforation (as in *Case* 2), and prejudice the success of the usual operative treatment of the ulcer (as in *Case* 3). The association of a gastric ulcer with duodenal ileus is one which I have met with, and, from the patient's long history, it appeared that the latter was the preceding condition. The frequency with which so-called acute gastromesenteric ileus has supervened after operation on the biliary passages has led more than one observer to ask whether a chronic duodenal obstruction was not present before the acute obstructive symptoms supervened.

The escape of duodenal contents through a biliary fistula in a case of bilious vomiting after an operation on the common bile-duct demonstrated to me the possibility of duodenal obstruction leading to infection of the biliary passages. Similarly, the finding of marked dilatation of the duodenum at a post-mortem on a fatal case of acute hæmorrhagic pancreatitis suggested that duodenal stasis might have led to the entrance of infective duodenal contents into the pancreatic duct, and activation of the pancreatic ferments.

These are questions, however, on which much more evidence than I can furnish must be brought forward before any conclusions of value can be drawn.

Relation of Duodenal Obstruction to Vicious Circle after Gastro-enterostomy.—Among the numerous causes of disappointment after gastro-enterostomy cited by Moynihan,[10] this condition finds no place. None the less I am convinced that it is one of the common causes of trouble, and particularly of regurgitant vomiting after that operation. Most surgeons can recall cases in which, under the diagnosis of duodenal or gastric ulcer, the abdomen was opened and no ulcer found, but possibly some dilatation of the first part of the duodenum noted, and in which a gastro-enterostomy was performed. All surgeons are unanimous now that the operation in such cases was a mistake, familiar as they are with the frequency of its post-operative troubles. When the question of re-operating in such cases is raised, the possibility of duodenal ileus should be kept in mind and the advisability of a duodenojejunostomy considered. Moreover, even although a duodenal or a gastric ulcer be present, if, in the history of the case, long-standing flatulent dyspepsia with attacks of vomiting be prominent features, and if, at the operation, unmistakable dilatation of the duodenum be present, the advisability of a duodenojejunostomy, either alone or along with a gastro-enterostomy, should be seriously thought of.

In one of my cases, in which the history of pain and discomfort extended over thirty years, and in which the duodenal dilatation was extreme, there was a well-marked gastric ulcer on the lesser curvature of the stomach. A duodenojejunostomy was performed, and the ulcer was left alone. The patient's pain, which had been pronounced, and all the other symptoms, disappeared after the operation, and she has remained well.

I have purposely considered the whole question of duodenal ileus as it has presented itself to me. Since making most of those observations I have discovered that both in America and in France other observers have reached conclusions almost precisely the same. Thus, Finney,[11] Stavely,[12] Codman,[13] Bloodgood, Spence and Graham,[14] and Kellogg[15] have all recognized the condition and treated it on similar lines: Kellogg,[16] indeed, in a recent article, reports over forty cases in which he has done the operation of duodenojejunostomy. The operation was first suggested by Barker in 1906, and was first performed by Stavely in 1908. In France, Duval, Delbet,[17] Grégoire, Villette, Savariaud,[18] Kotrereff,[19] and others have recently reported cases some of which were successfully treated by duodenojejunostomy. From Australia, Devine[20] reports three cases successfully treated on similar lines. Without entering into any analysis of the recorded cases, one may state that the clinical picture and operative findings in all coincide with and confirm the observations which I have made, and strengthen my conviction that we are here dealing with a pathological and clinical entity. In this country the condition has, so far as I am aware, received practically no attention, and this paper is published with the object of directing attention to the recognition and treatment of a class of case which has hitherto defied surgical treatment.

CONCLUSIONS.

1. Chronic duodenal ileus from compression of the third part of the duodenum by the root of the mesentery is a clinical and pathological entity.

2. It may be associated with duodenal or gastric ulcer, and with biliary and pancreatic lesions.

3. Visceroptosis, and congenital lack of fixation of the proximal colon, predispose to its development.

4. Fixation of the proximal colon may relieve certain cases.

5. Drainage of the dilated duodenum by duodenojejunostomy is the most certain method of treatment, and the only one suited for well-developed and late cases.

6. Acute dilatation of the stomach, either idiopathic or post-operative, is probably merely a gross manifestation of a previously present chronic condition.

I wish to express my thanks to Mr. J. W. Dowden for his kindness in allowing me to study the pathology and to publish the notes of *Case* 3, which was under his care, and to Mr. J. N. J. Hartley for his assistance and helpful advice in the study of some of these cases.

REFERENCES.

[1] DWIGHT, *Jour. Anat. and Physiol.*, 1897.
[2] GLÉNARD, *Presse méd. Belge*, 1889, xli, 57.
[3] DUBOSE, *Surg. Gynecol. and Obst.*, 1919, Sept., 278.
[4] DOWNES, *Ann. of Surg.*, lxvi, 436.
[5] BLOODGOOD, *Jour. Amer. Med. Assoc.*, 1912, lix, 117.
[6] GRÉGOIRE, *Bull. et Mém. Soc. de Chir.*, xlvii, 786.
[7] VILLETTE, *Ibid.*, 552.
[8] DUVAL, *Ibid.*, 597.
[9] LEVEUF, *Rev. de Chir.*, 1920, No, 11, 616.
[10] MOYNIHAN, *Brit. Med. Jour.*, 1919, July 12.
[11] FINNEY, *Johns Hop. Hosp. Bull.*, 1906, Jan., 37.
[12] STAVELY, *Surg. Gynecol. and Obst.*, xi, 288.
[13] CODMAN, *Boston Med. and Surg. Jour.*, 1908, clviii, 503.
[14] SPENCE and GRAHAM, *New York Med. Rec.*, 1913, Sept., 473.
[15] KELLOGG, *Surg. Gynecol. and Obst.*, 1919, Feb., 174.
[16] KELLOGG, *Ann. of Surg.*, 1921, May, 578.
[17] DELBET, *Bull. et Mém. Soc. de Chir.*, 1920, March, 471.
[18] SAVARIAUD, *Ibid.*, June, 887.
[19] KOTREREFF, *Ibid.*, April, 775.
[20] DEVINE, *Med. Jour. of Australia*, 1921, Feb., 128.

TESTICULAR SYMPTOMS IN APPENDICITIS.

By ZACHARY COPE, London.

So far as I am aware, the testicular symptoms in appendicitis have never claimed more than a casual notice in even the most exhaustive treatises on the subject of appendicular disease. Most writers do not seem to be aware of their occurrence. Yet the subject is of considerable importance, for misdiagnoses may result from lack of appreciation of the symptom.

Testicular pain or discomfort occurs in probably about 5 per cent of the cases of appendicitis occurring in the male. The pain is often not so severe as the general abdominal pain, and may not be complained of by the patient unless he be directly questioned on the point. The pain is either a dull aching or of a sharp shooting nature.

ILLUSTRATIVE CASES.

Case 1.—A medical man, age 27, who was known to have a mobile right kidney, was one morning seized with rather vague pain in the hypogastrium and dull pain in the testicles. There was no vomiting, but acute loss of appetite, and nausea. Flatulence and discomfort were experienced in the right renal region. The patient himself thought that he was suffering from a Dietl's crisis, and this opinion was concurred in by a surgeon who saw the case within eight hours of the onset. After rest in bed for a week the symptoms abated, an abdominal belt with special renal pad was ordered, and the patient allowed to go away to the seaside. A week later he noticed a rather tender lump in the right iliac region, and felt the renal pad irksome. Thinking the kidney might have become displaced again, he returned to town, where his temperature was found to be 101°. Examination revealed a fluctuant swelling, and a large appendicular abscess was successfully drained. The patient later extruded a concretion from the sinus left after drainage. When appendicectomy was undertaken a month later, only the stump of the appendix was found attached to the cæcum.

Case 2.—B. S., a man about 30 years old, was taken with vague right-sided abdominal pain, May 12, 1914. During the night the pain became much worse, and he vomited. When I saw him at 6.30 a.m. on the 13th, there was pain on pressure at the right erector-costal angle, and some rigidity of the anterior abdominal muscles on the right side. He complained that the pain went down into the right testicle, and that the day previously his urine had been dark-coloured. Provisionally I diagnosed renal colic, gave morphine, and arranged for an *x*-ray photograph to be taken. The radiogram showed a shadow just external to the line of the ureter which the radiologist said was probably a calcareous gland. In view of the symptoms I thought this might be a stone in the ureter, and after cystoscopy I explored the right ureter by open incision. The ureter was quite normal, but on opening the peritoneum at the anterior part of the wound I found and removed an acutely inflamed appendix—non-adherent and unperforated—with a calcified gland the size of a hazel-nut embedded in the appendicular mesentery.

Case 3.—Mr. G. History of five days' illness with abdominal pain, vomiting, fever, and abdominal distention. No trouble with micturition, but had some pain in the *left* testicle. I opened a large pelvic abscess on the sixth day of the illness.

Case 4. (not under my care).—H. C., age 26. History of abdominal pain, first epigastric, then right iliac. Pain also radiated to the right testicle. Neither vomiting nor nausea. Two days later pain still in right iliac fossa and right testicle. Operation revealed a gangrenous appendix in the right iliac fossa.

Case 5.—Mr. D., age 58, at 11 a.m. on the morning of Feb. 20, 1921, felt a severe pain in his left testicle. For an hour and a half this pain was unaccompanied by any other symptoms, but at 12.30 there ensued generalized abdominal pain. Later, the pain settled in the right iliac region. There was anorexia, but no nausea or vomiting. Two days later, when I saw him, there was definite evidence of abscess formation in the right iliac fossa. I opened the abscess, and removed a perforated appendix lying on the iliopsoas muscle. There was a concretion in the appendix, and the appendical mesenteric vessels were thrombosed.

In all these recorded cases the testicles showed no sign of local inflammation or disease. I have seen at least two other cases, but these five serve to illustrate the main facts, which may be summarized as follows :—

Pain in either the right or left testicle, or in both testicles, may accompany acute appendicitis. This pain is due to the appendical disease, and is not dependent on any disease of the genito-urinary system.

Though the testicular pain is usually associated with perforation of the appendix, it may accompany appendicitis without perforation (*Case* 2).

The testicular pain may precede the onset of the abdominal pain by at least an hour or two, though this is unusual.

The duration of the pain may be short or as long as two days.

Cause of the Pain.—Whilst it is tempting to suggest that direct irritation of the sympathetic nerves accompanying the spermatic artery may account for the testicular pain, yet the facts that the pain may be on the left side, and may occur with an unperforated appendix, negative that explanation for at least some of the cases.

The sympathetic nerve-supply of the testicle is from the tenth spinal-cord segment, whilst fibres from the first lumbar go to the cord and cremaster. I believe there is clinical evidence to show that the appendix is supplied chiefly from the tenth spinal-cord segment. May the testicular pain not be explained most easily as a pure referred pain, since the appendix and testicles appear to be supplied by the same cord segment.

When a pelvic abscess has formed, possibly direct irritation of the vasa deferentia or seminal vesicles might cause testicular pain.

Retraction of the Testicle is occasionally noted in appendicitis. This may be due to irritation of the genitocrural nerve causing a contraction of the cremaster.

As evidence of the importance of the testicular symptoms in appendicitis, one need only read the account of the first two cases, where renal conditions were diagnosed in consequence of the pain in the testicle. In one of these the correct diagnosis was not made till a large abscess was detected a week after the onset of the illness.

FRACTURE OF THE HUMERUS IN AN INDIVIDUAL WITH OBSCURE BONY LESIONS.

By E. E. HUGHES, Manchester.

This case is put on record with the hope that, in the light of further knowledge, a more satisfactory interpretation of the bony lesions described may be forthcoming than is given here.

The patient, age 55 years, a foreman plumber by occupation, boarded a slowly-moving tram-car in Manchester in January, 1921. To gain the platform he grasped the vertical hand-rail of the car with his right hand and sprang on to the lower step. In doing so he experienced a sensation as though the rail had given way, and on releasing his hold the arm fell to his side and he realized that it had

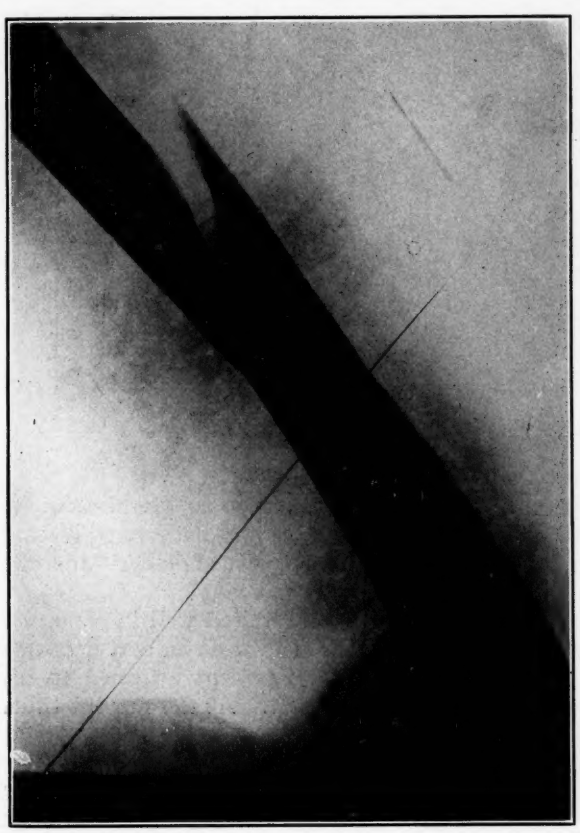


FIG. 206.—Right humerus, showing oblique fracture at junction of middle and lower thirds, atrophy of compact bone, and cystic disease of lower fragment.

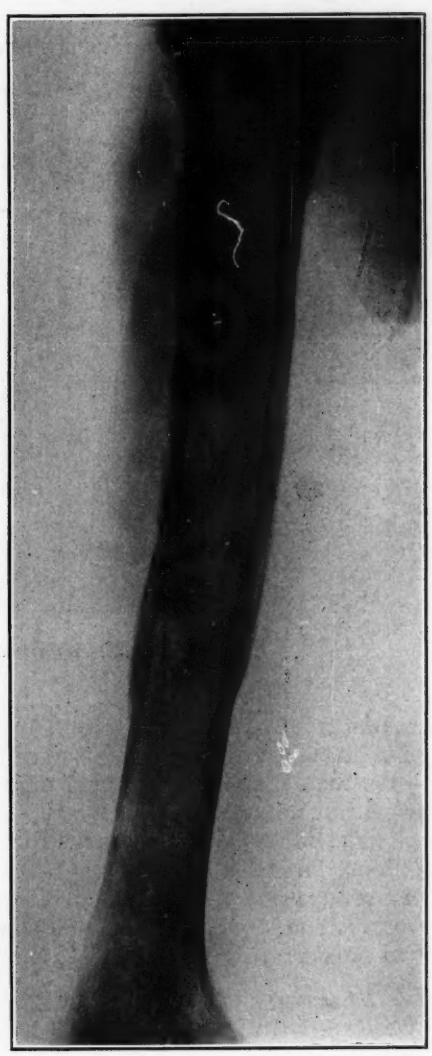


FIG. 207.—Left humerus, showing cystic disease and periosteal new bone formation.

sustained some injury. The car took him past the Central Branch of the Manchester Royal Infirmary, where he alighted to seek treatment. A fracture of the right humerus was diagnosed, and confirmed later by a radiograph (*Fig.* 206), and on 15th January he was transferred to the out-patient department, where he first came under my notice.

My first impression was that there was a pathological fracture occurring in a humerus the seat of a new growth, possibly a secondary carcinoma. An examination was therefore made of those organs carcinoma of which is specially liable to produce metastases in bones. This examination gave a negative result. A request was then made for a radiograph of the *left* humerus for purposes of comparison. The receipt of this radiograph (*Fig.* 207) led naturally to a more extensive examination of the osseous system, and further radiographs were taken (*Fig.* 208 to 210) after a preliminary screening suggested by Dr. J. B. Higgins.

Meanwhile a history of syphilis (chancre) thirty years previously, and for which he was treated with medicine for a couple of years, was obtained; and a Wassermann test

FIG. 208.—Upper end of left humerus, showing extensive cystic disease.

was returned as being positive in 1–40 dilution. The patient showed no collateral evidence of syphilis, external examination of the bones gave no indication of any underlying disease —the man himself complained only of a little rheumatism in the left shoulder—and the urine was normal.

The subsequent history may be stated briefly. The fracture united well in a normal fashion, immobilization was entirely discarded at the end of fourteen days, and a course of massage and movements instituted. At his own request the patient returned to his work, which involved no manual labour, a month after the accident. At the present time, two months after the accident, the limb is fully functional.

Observations.—1. *The Fracture.*—The etiology of the fracture is of some interest. Although I am now of opinion that it was caused by muscular contraction, I do not think that the pathological condition of the bone can be altogether disregarded. It is unlikely that such an accident would occur to a normal bone, and I therefore consider that the pathological condition of the bone is to be regarded as a strong predisposing cause. The

obliquity of the fracture also is a point in favour of an exciting cause by indirect violence, which in this case, I take it, is muscular contraction.

2. *The Bony Lesions.*—In endeavouring to elucidate the etiology of a number of lesions in the same individual, one invariably seeks a common cause. In this particular case it may be that syphilis is the sole causative factor, but there are difficulties in effecting a total reconciliation.

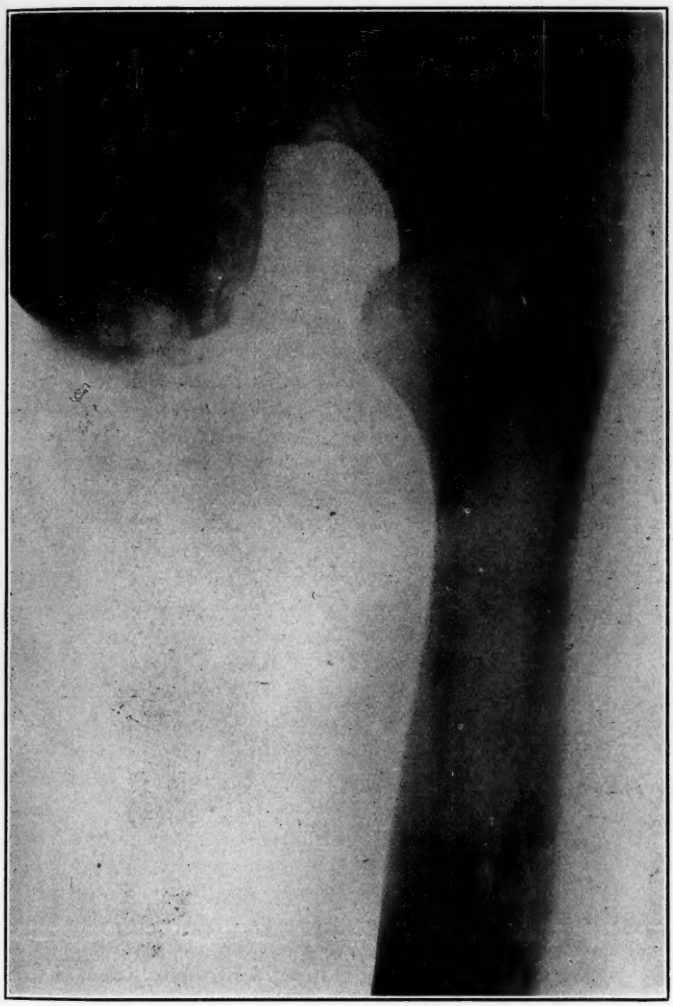


FIG. 209.—Right femur and ischium, showing rarefaction (? cystic condition) of great trochanter; periosteal thickening, with tendency to formation of cysts, of femoral shaft; and cystic disease of ischium.

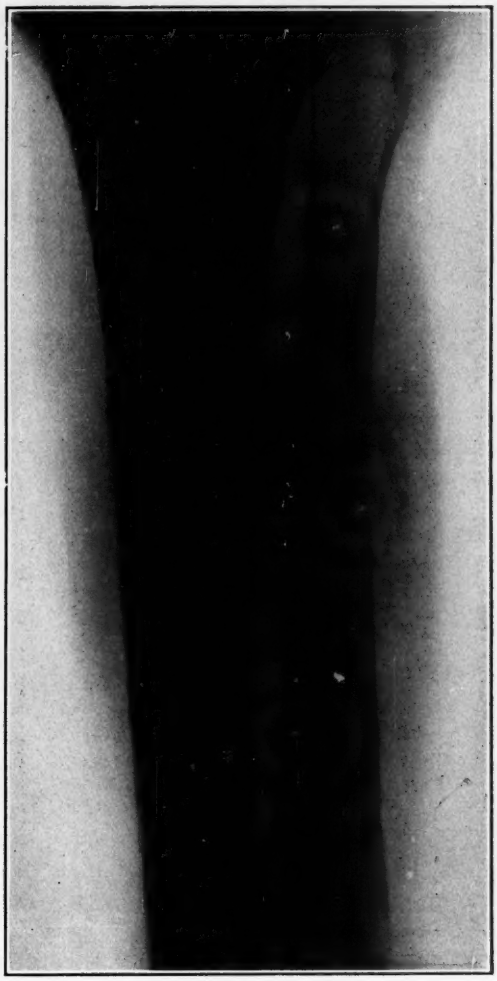


FIG. 210.—Right tibia and fibula, showing fibrous hyperplasia of fibula.

The lesions may be roughly grouped as follows :—(1) Fibrous hyperplasia, seen in the right fibula ; (2) Cystic degeneration, seen particularly in the left humerus and also in the right humerus, right ischium, and both femora ; (3) Periosteal new bone formation, seen especially in the right ilium and right femur ; (4) Atrophy of the compact bone of the right humeral shaft.

The first and second groups strongly suggest osteitis fibrosa and osteitis fibrosa cystica respectively. These diseases are possibly related to syphilis, although the relation has

not yet been definitely established. The absence of any bending of the affected bones is a noteworthy feature.

The question of new growth has been considered, but, as already stated, no extraneous malignant disease was found, and the rapid union of the fracture disposes of the possibility of a primary malignant growth of bone. Absence of an albumosuria disfavours a myelomatosis.

The third group is probably of syphilitic origin, but I am at a loss to account for the atrophy of the right humeral shaft.

The patient is now undergoing a course of salvarsan treatment, and it will be interesting to observe to what extent, if any, these lesions show a disposition to change.

My thanks are due to Dr. A. E. Barclay and Dr. J. B. Higgins, of the radiological department of the Manchester Royal Infirmary, for the radiographic prints.

NOTE ON A SERIES OF 100 OPERATIONS FOR GALL-STONES IN PRIVATE PATIENTS: WITH SPECIAL REFERENCE TO RECURRENCE.

By Sir GILBERT BARLING, Birmingham.

In February last I was asked to see a lady, age 74, upon whom I had operated some years previously for gall-stones in the gall-bladder and common duct. The gall-bladder was removed, the duct cleared of soft, mortar-like stones, washed out, and drained. A good recovery followed, and the patient remained perfectly well for nearly six years, when she experienced a severe attack of pain in the upper abdomen, without vomiting, and this was followed by jaundice in a day or two. After a few days in bed the jaundice quickly diminished, and the patient was allowed to get up, but a return of pain followed, with increase of jaundice, again without vomiting. I saw the patient on this occasion, and found her moderately jaundiced and with some tenderness over the tail of the pancreas. She described her attacks of pain as a bad stomach-ache, and as different from the pain of her old attacks of colic. I thought it probable that her recent illness was due to pancreatitis rather than to recurrence of stone in the common duct. When I saw the patient again she had suffered attacks of pain with vomiting, which in the opinion of her medical adviser, Dr. Starkie, were fairly typical of gall-stone colic.

At the second operation, on May 22, exposure of the common duct was fairly difficult owing to old extensive adhesions; the duct was occupied by masses of soft, ill-formed stone; it was cleared, syringed out, a large bougie passed into the duodenum, and a good recovery followed.

The experience of this patient induced me to undertake an inquiry into the subsequent history of gall-stone cases, and for this purpose I have investigated the history of my last 100 cases operated upon in private, the difficulty of obtaining subsequent history from hospital cases being too great.

Of the 100 cases, 6 died as the result of the operation, or of conditions present which were beyond control. One patient, a male, age 31, a mentally defective, had a perfectly simple operation for stones in the gall-bladder only; there was little manipulation, and the gall-bladder was drained. I did not see the patient again, but was informed that for six days progress was perfectly satisfactory, and then a condition set in which was ascribed to acute myocardial failure, and the patient died in three days. The second death was in a lady of middle age, upon whom I had operated seven years previously for intestinal obstruction arising immediately after parturition. To relieve the obstruction, which was due to growth in the transverse colon, a colotomy was performed. Twelve days later, when I proposed to remove the growth, I found on re-opening the abdomen that in addition to the carcinoma which was the actual cause of the obstruction, the colon was the site of widespread papillomata, and it was necessary to excise the colon from the cæcum to the sigmoid flexure, these two portions being then united by lateral anastomosis. The patient remained well for six years, and then suffered symptoms of gall-stone, for which I operated in April, 1918. I do not remember that I have ever had greater difficulty in finding the gall-bladder; adhesions of the densest character existed everywhere, and the organ itself was very shrunken. Stones were removed from it and from the common duct. Around the latter there was a collection of pus. In the later stages of the operation some large vein was torn, either the portal or one of its immediate tributaries. Much blood was lost in trying to secure this, and

eventually I left forceps on; but hæmorrhage recurred, and from this the patient died. Looking back on this, I wonder whether I should have done better to persist in my endeavour to tie the vessel in a patient profoundly shocked by a severe and prolonged operation and loss of blood. In one other case in which I had similar difficulty, the closure of the vessel by forceps was carried out safely. The remaining deaths were in patients very undesirable subjects for any operation. One, a male, age 68, gouty and alcoholic, with stone in the common duct, rigors and high temperature, died on the fifth day after operation. The second, a doctor, age 58, alcoholic and deeply jaundiced, had stones in the gall-bladder, a greatly dilated common duct from the pressure of a chronically inflamed pancreas, and also severe cirrhosis of the liver; he died on the following day. The third, a male, 60 years of age, the subject of gall-stone attacks for ten years, with recent severe illness associated with high temperature but free from jaundice, had suppuration around his gall-bladder, and died in a few days from a spreading peritoneal infection. The fourth patient was a feeble elderly lady with stone in gall-bladder and common duct, and she died from shock on the day following operation.

On looking over the table of the 100 cases, the most striking feature is the more frequent removal of the gall-bladder as an alternative to draining it in the later cases of the series. In the last 50 cases, the gall-bladder was removed in 40; but in the first 50, removal was effected only in 13 cases. I suppose that my practice of removing the gall-bladder as a routine procedure now, is similar to that of other surgeons. There is much to be said for the practice; always an infected organ in the presence of stone, I doubt if it is ever freed from infection by draining it; thus conditions remain which caused formation of stone in the first instance. The absence of the gall-bladder appears to me as little harmful as the absence of the vermiform appendix; but other cases similar to that described at the commencement of this note have occurred in my practice, and give occasion for thought, and to this point I return later. One thing perfectly clear in my mind is that patients recover more easily and quickly if the gall-bladder is removed rather than drained; there is less likelihood of infection of the abdominal wound, and the scar is firmer. At first rather conservative in removing the organ, fearing that it implied some additional risk, I have now arrived at the conclusion that removal does not add to the risk, excepting in such conditions as I am about to mention. In my later cases abstention from removal has been due to widespread suppuration round the gall-bladder, to the desire to shorten the operative measures in feeble patients—as for instance those with extensive pancreatitis—or to the fact that the patient has given rise to anxiety with regard to the anæsthetic.

In one patient whose gall-bladder had been removed by another surgeon, I had to perform gastrojejunostomy for the relief of pyloric obstruction due to dense adhesions puckering the pylorus into the bed formerly occupied by the gall-bladder, a warning that every precaution should be taken to cover with peritoneum any raw surface. In four patients whose gall-bladders were not removed, the stones had ulcerated through, and lay in a collection of pus adjacent.

Of the 100 patients, 35 had stone in the common duct, and many of them had pancreatitis; sometimes this was very limited and quiescent, but in a few the involvement was extensive, and associated with fat necrosis. One patient, a male, also had stone in the head of the pancreas, and gave much trouble owing to the digestion of the wound edges by the pancreatic secretion: this ended in a large ventral hernia. In two cases it was necessary to open the duodenum for stone impacted in the ampulla; both recovered and have remained well since. One patient, who had suffered from typhoid fever eighteen years before, and whose gall-bladder was removed, provided a pure cultivation of *B. typhosus*, and her blood what was described as a fading Widal reaction. So far as could be traced she had not infected other people. As a general rule, when operating for gall-stones, I remove the vermiform appendix, and on two occasions in the hundred cases I also performed gastrojejunostomy for severe stenosis due to duodenal ulcer.

In the 100 cases the gall-bladder was drained in 47 ; of these, 5 died, leaving 42 for investigation. In one, a young married woman, symptoms recurred in a few months, when I removed a typical strawberry gall-bladder, which would have been excised at the first operation but that she gave rise to much anxiety from the anæsthetic. In one a sinus remained for months, then healed and again broke out, when the gall-bladder was removed by another surgeon during my absence from England ; this was one of the patients in whom stones had ulcerated through into the abdominal cavity lying in a collection of pus, and I was desirous of reducing the manipulations to a minimum. In one patient symptoms returned soon after the operation, and further operation was refused ; in one other, symptoms recurred some years after operation in 1912, but no further operation has been required.

Of the 53 cases in which the gall-bladder was removed, 1 died. Of the remaining 52, 3 have had symptoms suggesting further formation of gall-stones ; the case related at the beginning of my note is one of these. A second was in a lady, residing now in South America, who wrote to me five and a half years after her operation, saying that she had a return of symptoms with jaundice, but I have not been able to trace her since. The third, a male, remained quite well for five and a half years after his gall-bladder was removed ; then he had a severe chill due to exposure to wet, which was followed by discomfort in the epigastrium, and jaundice. These conditions were associated with fullness and tenderness over the pancreas ; the symptoms diminished, and then intensified over a period of three to four months ; there was no definite attack of colic. Eventually the patient recovered completely, and he has remained well for fifteen months. My diagnosis was pancreatitis.

That stone may recur after removal of the gall-bladder is proved by my notes, and I may refer to a hospital case in which, when removing a much-deformed gall-bladder, I pulled up and ligatured the common duct. For some months the whole of the bile discharged through the wound ; the abdomen was then re-opened ; with great difficulty both ends of the common duct were found, with a gap of half an inch between them, the parts of the duct were freed, and the ends sutured around a decalcified bone drain. No drop of bile escaped after this, but three years later the patient returned with jaundice and symptoms suggesting further stone. The abdomen was re-opened, and one stone removed from the common duct ; but the point where the duct had been reunited could not be recognized.

CONCLUSIONS.

1. Removal of the gall-bladder rather than draining it should be the routine procedure.

2. An easier and safer recovery follows.

3. Removal of the gall-bladder does not prevent recurrence of stone in the common duct, but I see no reason to believe that it adds to the likelihood of recurrence.

CYSTIC DISEASE OF THE FIRST RIB CAUSING LOWER-ARM (KLUMPKE) TYPE OF PARALYSIS.

By W. C. B. MEYER, London.

History.—Patient was a man, age 52, complaining of: (1) Swelling in the left supraclavicular region; (2) Wasting of the left hand; (3) Numbness of the inner side of the forearm and hand; (4) Pain behind the left shoulder and down the inner side of the left arm and elbow.

1. The swelling appeared gradually and painlessly four years ago. The patient was rather vague about some blow sustained during rifle drill. The tumour increased to its maximum size, namely that of a Tangerine orange, in about six months, and then remained stationary.

2. The wasting of the left hand was noticed about a month later, after weakness of this member had attracted his attention. Slowly the inner two fingers stiffened and contracted, and his hand became somewhat clumsy; but he never lost the power of bending his fingers or his wrist.

3. The numbness of the inner side of the forearm and hand appeared some considerable time after the weakness and wasting.

4. Pain behind the left shoulder and down the inner side of the left arm and elbow was his main complaint. He first had some pain about eighteen months ago, which, slight at the beginning, gradually got worse until, two months before operation, it caused him to lose sleep. It was most severe in the mornings, which he attributed to a subconscious habit of assuming a left-side position in sleep. The pain was of a stabbing or shooting neuralgic character, and though it originally went down his forearm, subsequently it got no further than his elbow, where it remained all day. Pressure against the left shoulder in leaning against anything brought on pain along the inner side of the upper arm, which was rendered so irritable that he could not bear even his shirt to touch it.

Examination.—

1. A tumour was revealed, in size and shape rather like a Tangerine orange, between the posterior border of the left sternomastoid and the anterior border of the trapezius, its lower margin encroaching over the clavicle superficially. It was soft, non-fluid, non-pulsatile, with a smooth surface, presenting three or four distinct lobulations, and with a very clearly-defined edge. It moved remarkably freely in all directions, was subcutaneous, and the skin moved easily over its surface.

2. The left hand was typically ape-like, with marked wasting of both median and ulnar intrinsics, with contracture of the little finger and, to a lesser degree, of the ring finger. The joints of these two fingers could not be straightened. The skin over the ulnar area of the hand and of the lower third of the inner aspect of the forearm was somewhat blue, dry, and rough, and thickened over the palm. There was slight general wasting of the whole of the left forearm, and more marked atrophy along the inner border. There was no interosseal movement of the fingers, but he could strongly flex these and the wrist. On testing sensation before operation there was both protopathic and epicritic loss right up to the elbow along the ulnar side of the forearm and over the ulnar fingers (inner $1\frac{1}{2}$). The photograph (*Fig.* 211) shows the sensory chart some four weeks after operation.

3. There was no change in the radial pulse when the arm was raised and depressed.

4. There was definite paralysis of the cervical sympathetic, as shown by a markedly

constricted pupil, slight enophthalmos, and absence of ciliospinal reflex on pinching the neck.

The *x*-ray (*Fig.* 212) showed—

1. The left first rib—more particularly its posterior half—to be full of cystic spaces, and the rib itself to be expanded and irregular in outline.

2. The left transverse process of the first dorsal vertebra to exhibit the same cystic change.

3. In addition to the shadow cast by the superficial tumour, one due to a second deeper tumour involving the area of the cupola of the pleura.

Dr. Acland's clinical report on the apex of the left lung was: "There is no evidence of any involvement of the lung". Dr. Levick's report on the electrical reactions of the

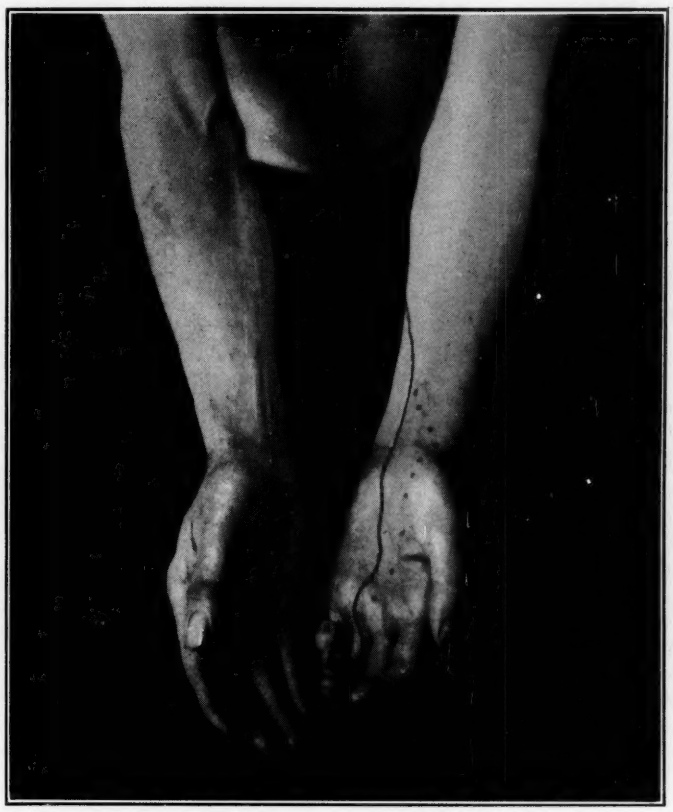


FIG. 211.—Photograph of patient, illustrating: (1) Ape hand and contracture of ulnar fingers; (2) Area of sensory loss four weeks after operation.

muscles of the hand was: "Interruption to the nerve-supply of all the intrinsics of the hand except the adductors of the thumb".

Diagnosis.—The chief interest of the case lay in the diagnosis. Obviously there was pressure causing almost complete physiological interruption of the first dorsal nerve-root—the only evidence of incompleteness being some faradic response in the adductors of the thumb. The eighth cervical root was also suffering from pressure, because the wrist flexors, though not completely paralyzed, were wasted and weak. The second dorsal nerve showed irritative sensory pressure signs, namely pains down the inner side of the upper arm as far as the elbow, and pains referred to the back. Again, it was clear that either the expanded first rib or the deep tumour, or both together, could cause these pressure symptoms.

But what was the nature of the disease which would cause multiple cystic expansion of a rib and a portion of a vertebra, and in addition produce two tumours, the superficial one of which had all the clinical features of a subcutaneous lipoma? It was not *chronic inflammatory*, for tubercle, syphilis, and actinomycosis could be excluded on *x*-ray evidence alone, and fibrocystic disease of bone would not explain the extra-osseous tumours. A *neoplastic* origin of the bone condition could only be explained by a myeloma rupturing through a thinned bony capsule, and infiltrating the surroundings; but a pulsating irregular and more deeply-seated tumour would then have resulted. No malignant tumour could have furnished the clinical picture presented. Among *parasitic* conditions producing cysts in bone, that due to the *Tænia echinococcus* was considered, but since on the one hand the supraclavicular tumour was so mobile on the deeper structures, so lobulated, so semisolid and nonfluctuant, and since on the other hand the patient had never come into close contact with dogs, this diagnosis did not seem to explain all the phenomena.

FIG. 212.—Skiagram illustrating: (1) Cystic 1st rib; (2) Faint outline of the superficial tumour; (3) Outline of deep tumour displacing pleura.

The operation, done by Mr. R. C. Elmslie, established the diagnosis of *hydatid disease of the first rib*, the superficial and deep tumours being connected with the rib by perforations in the expanded bone. The superficial tumour had a long narrow pedicle leading to the first rib, while both tumours were filled with a thick creamy substance, which closely resembled the sebaceous secretion of dermoids, but was entirely odourless.

The Operation.—An incision was made parallel to the anterior border of the trapezius. The superficial tumour was found to have two sheaths, the outer apparently being derived from stretched deep fascia of the neck; the inner was very delicate, and formed a narrow pedicle dipping deeply between the scalenus medius and anticus to communicate with a perforation in the bone. On approaching the first rib, dissection ruptured this membrane, and the wound became filled with a large amount of the sebaceous-like, curdy débris. The external respiratory nerve of Bell was sought for on the scalenus medius, and the union of its two upper roots was retracted back. The rest of the brachial plexus lay in front, and was retracted forward. The scalenus medius was stripped from

the rib, exposing three perforations in the greatly expanded bone. Through these perforations quantities of the same curdy substance exuded. As much of the rib as could be reached was removed posteriorly by means of bone-cutting forceps, and anteriorly the rib was divided below the subclavian artery. The interior of the ends of the bone was scraped with a sharp spoon. Removal of the expanded portion of the rib exposed the deep tumour which had displaced the apex of the pleura. Its capsule, bounded by thickened pleura below and internally, by the upper two ribs externally and behind, and by the scalene group above, was scraped. Among the débris from the lower and deeper tumour were found five or six transparent round and ovoid exogenous hydatid daughter cysts, the size of beans. The wound was drained for four days and then healed by primary intention.

Pathological Report, BY DR. H. A. HAIG.—"Daughter cysts of varying size present: from these scolices of *Tænia echinocöccus* were obtained. Fluid in cysts contains numerous cholesterin crystals."

After-result.—Five months later the patient had protopathic and some epicritic sensation in the whole of the previously anæsthetic area, and complete relief from pain. There was faradic response in all the intrinsic muscles of the hand except the opponens and flexor brevis pollicis, the fourth dorsal interosseous, and the abductor minimi digiti. There was also return of the ciliospinal reflex.

TUBERCULOSIS OF THE FLAT BONES OF THE SKULL.

By VALENTINE ST. JOHN, Transylvania.

This affection was until recently considered to be a rare one, if we are to judge from the scant attention given to the subject in our text-books, and individual experience will be found to support this view. None the less a good many cases have been reported of late, and Pelletier in 1910 collected statistics of 206 cases, presumably from all sources. The maximum number of cases observed in a limited period of time are those published by Wieting and Raif Effendi, under whose notice there came ten cases within twelve months. In twenty years I do not recall having seen a single case, and yet in 1919 and 1920 no less than four came to me for treatment. This paper is founded on the experience derived from the observation and treatment of these cases, of which the first two have already been published in a foreign journal.[1]

Tuberculosis of the flat bones of the cranium is in the majority of cases associated with obvious tuberculous lesions in other parts, and, as would be expected, more particularly with lesions of bones and joints. Pelletier regards the association as constant, while Wieting and Raif Effendi have reasons for considering cranial tuberculosis as frequently solitary. Of the four cases reported below, two had multiple tuberculous lesions, one had pulmonary tuberculosis, and of the fourth all that can be said is that extracranial lesions were not noted while the patient was under observation.

Children and adolescents are more frequently affected than adults. Two of our cases, however, occurred in adults, and Lenormant's[2] two patients were also adults. In Pelletier's paper it is noted that, of 161 cases, 128 occurred before the twentieth year, 19 between twenty and forty, and 14 after forty.

The bones most frequently attacked are the frontal and parietal, and a long way behind these come the temporal and occipital. Two forms of the disease are generally recognized, the one represented by a localized necrosis, known as the *perforating* form (Volkmann, Gangolphe), the other by a *diffuse progressive infiltration* (Koenig).

The number of perforations which may be found in the first form is very variable. Roger[3] has recently given a description of a solitary perforation found in the course of a post-mortem examination, and Bergmann considered a single perforation to be the rule, although he counted seven in one case. Ménard records having found no less than twenty-nine perforations of the skull in a child. But it remains to be seen of what significance the perforations are.

It has been the custom to regard each perforation as representing a separate focus. This is certainly a mistake. In a previous publication on the subject I expressed my doubts as to the actual existence of two separate forms of tuberculosis of the cranial vault, in spite of the distinction having become almost classical. My opinion was that the conception of two separate forms was the result of an erroneous interpretation of pathological findings, the consequence largely of incomplete observations. To quote a passage from the publication referred to: "Is not Ménard's case an example of the diffuse tubercular variety, presenting simply an exceptional number of perforations, which nevertheless may not be out of proportion to the extent of the disease? And does not the subject of our first observation, whose skull was infiltrated to a remarkable degree, presenting a large granuloma and numerous perforations, belong to the same class? Without pretending to say the final word on a pathological subject of which the best of us can have only a limited experience, we may venture to express the opinion that the two forms described merely represent two distinct stages in the evolution of tuberculosis of the cranial vault".

To my satisfaction I find this view in some measure endorsed by Lenormant, who writes, no doubt with Ménard's case in mind: "We must clearly distinguish, when we find abscesses, fistulæ, or multiple perforations at a distance one from the other, between cases where there are really independent and completely separated foci, and those—probably the more frequent—where these abscesses or fistulæ are only the outward expression, at divers points on the cranial vault, of a vast focus, diffuse and yet unique, having its seat in the diploe or between the bone and the dura". Lenormant objects to the term 'perforating', and suggests very rightly that we should recognize only a *circumscribed* and a *diffuse* form. Further observation will, no doubt, establish the fact that *there is but one form of tuberculosis of the cranial vault*, circumscribed in its early stages and diffuse in the later.

It is generally admitted that the disease commences in the cancellous tissue of the diploe, an opinion which is supported by what we know of the origin of tuberculosis of bone in other parts. Our cases entirely corroborate this view. Theoretically we can recognize an early stage when the process is limited to the diploe, but sooner or later it attacks the outer or inner tables, or both. Some observers seem to think that the disease spreads more rapidly through the inner table than the outer, but our cases do not bear this out. In *Case* 1 we gained the impression that the outer table was somewhat more widely affected than the inner; and in *Case* 3 we found a single perforation going down to the dura mater, the outer table, however, being destroyed much more widely than the inner, suggesting that the disease had advanced more rapidly in the former. Isolated cases of tuberculosis limited to the outer table, or to the inner—a fact more difficult of demonstration—have been reported, but they are rare. *Case* 2 of our series might be considered to illustrate the former, though its special features, perhaps, place it outside this category. *Case* 4 is commented on later.

But let us follow out the further evolution of the disease. As mentioned above, the process has a tendency, while spreading in the diploe, to attack here and there the tables of the skull. There are points at which both tables are invaded simultaneously, so that a single sequestrum is found involving the whole thickness of the bone. Bergmann's case affords evidence of this. He found in the midst of a tuberculous granuloma a fragment of the bony wall of the skull, measuring 10 mm. in diameter, in which were recognizable portions of both tables, including between them diploe infiltrated with caseous matter. It is thus seen that the sequestrum can be eliminated spontaneously. But the process of elimination must be tedious when the disease advances more rapidly in the inner table, for the sequestrum is then said to become wedge-shaped, having its base formed by the inner table. As a rule the sequestrum disappears through a process of disintegration, so that at the operation we find either a complete perforation or an orifice containing the friable remains of the disintegrated sequestrum.

But even before the sequestrum is eliminated or destroyed, the pathological process can reach the outer surface of the skull and give rise to a cold abscess. This will at first be subperiosteal, and may at this stage form a more or less resistant tumour, being subject to some pressure as it lies between pericranium and bone. The next step will be the perforation of the pericranium at some point and the outflow of pus into the lax cellular tissue beneath the scalp. The anatomical conditions now allow the pus to occupy a wider space, and, the tension having been relaxed, the tumour becomes softer and more distinctly fluctuating. Sooner or later the integuments will ulcerate if the abscess is left to itself, it contents will be evacuated, and there will form a fistula, which in no way differs from tuberculous fistulæ elsewhere. While exploring with a probe we may come upon denuded bone, which can only be the sequestrum, for the bone in its immediate neighbourhood is invariably smooth and to all appearance normal; on the other hand, if the sequestrum has disappeared, the point of the probe may become engaged in a perforation of the outer table and be stopped by the inner.

Let us now trace the progress of the disease inwards. The inner table may become invaded in a similar way to the outer, and this may or may not take place at a point opposite to the site of the necrosis in the latter, though this is frequently the case. The

bone tissue becomes destroyed, the dura mater is exposed and becomes the seat of an external pachymeningitis. It becomes thickened and covered with granulations, which may extend in the subdural space well beyond the limits of the bony necrosis. If the perforation thus involves the whole thickness of the skull, the point of the probe may abut against the thickened dura, which presents a more or less elastic resistance. It frequently happens that this thickened dura no longer pulsates.

It is very unusual to find a cold extradural abscess that has formed *in situ*. But of course there is no reason why a cold abscess formed on the outer surface of the skull should not communicate through a perforation with the subdural space.

Having traced the process outwards and inwards, let us see how it spreads in breadth.

We have noted that the disease may extend over a considerable area of the skull, and that the perforations may be numerous. Lenormant draws attention to the wide area of dura which may become invaded by fungous granulations, and makes the interesting suggestion that the disease may extend in some cases, not through the bone, but by means of the sheet of fungous matter situated between dura and bone. He is of opinion that these fungous formations reinoculate the bone on its deep aspect, and determine the formation, at a distance from the primary focus, of fresh points of necrosis, which in turn may lead to independent perforations. I gather that Lenormant suggests this as an alternative mode of invasion, and does not deny the spread of the disease in many cases, if not the majority, through the diploe. *Case* 1, our most important in this respect, emphatically supports the latter view. What Lenormant describes as taking place between dura and bone occurred in this case between inner and outer tables. The description of the conditions found at the time of operation will well bear perusal, being more instructive than any theoretical discussion. It will be seen that in *Cases* 1 and 3, at no point did the area affected by pachymeningitis spread far beyond the limits of the suprajacent bone disease, as in cases reported by other observers. On the other hand, we found in *Case* 1 a mass of fungous tissue occupying a large oval orifice in the centre of the forehead, forming here an extradural tuberculoma, and this seems to be an unusual feature.

The invasion of the frontal sinus in our first case is a unique complication. Panse once found the neighbouring cavities of the nasal fossæ filled with tuberculous masses, and noted caries of the roof of each orbit. This is the only observation of the kind of which I have been able to find an account. In our patient, however, there is nothing really remarkable in the circumstance if we recollect, on the one hand, that the frontal sinuses are developed between the two tables, and on the other, that the neighbouring diploe was invaded by disease.

It may be asked in what relation tuberculosis of the skull stands to tuberculous meningitis. Fortunately, in spite of the changes which the outer surface of the dura undergoes—or perhaps because of these changes—this membrane opposes an efficient barrier to the penetration of the disease, so that tuberculous meningitis is unusual as a complication. Delamare and Conor (quoted by Lenormant) noted it once in 15 cases, and in Pelletier's statistics there were only 9 cases of tuberculous meningitis and 4 of cerebral tuberculosis.

Symptoms and Diagnosis.—We now approach these somewhat thankless subjects, which are best dealt with together. The fact is that there is singularly little to be said on this point that is really pertinent, for in practice it has been found that the disease has but one symptom of any practical value, the cold abscess; and that the diagnosis, like the symptom, loses much of its worth from the fact of its coming too late. We are dealing with an insidious affection which can make astonishing progress without giving obvious signs of its presence, and which is consequently all the more dangerous. When a cold abscess forms in the frontal or parietal regions, we can of course no longer be in doubt as to the state of affairs, but this phenomenon, which was referred to above as a symptom, is better described as a complication, and, what is more, it is frequently a late complication. This is even more true of the tuberculous ulcer or fistula. A real symptom

would be headache; but this is often absent, and when present it is of equivocal value, since it is perhaps more frequently indicative of cranial syphilis than of tuberculosis. Indeed, in adults, syphilis is the more frequent of the two diseases, and we should be quite justified in first thinking of this complaint when a patient with even vague specific antecedents complains of violent and persistent headache. Under the circumstances there is no motive for surprise that the diagnosis became clear in *Case* 1 only after the abscess had formed. This patient had recently undergone a course of antisyphilitic treatment, and his occipital pain was both violent and tenacious. The fever was of practically no value as a symptom, being accounted for by the pulmonary phthisis; indeed, cranial tuberculosis of itself probably causes no rise of temperature unless a mixed infection has set in, and when it exists it can usually be ascribed to some pulmonary or other affection. It may be argued that the state of the lungs in *Case* 1 should have turned our thoughts in the right direction; but tuberculosis and syphilis often coexist in the same patient, and here the evidence in favour of syphilis was too strong. In the absence of a syphilitic history a provisional diagnosis of tuberculosis of the skull might have been made.

In *Case* 2 the patient, a child of 18 months, was brought to us for a swelling over the forehead, and the appearance of this, combined with a traumatic history, made us think at the moment of a subperiosteal hæmatoma, but the presence of a fistulous opening above the eyelid, and the use of a hollow needle, soon put us on the right track. *Cases* 3 and 4 were patients riddled with external tuberculosis, so that no diagnosis but the obvious one was admissible.

It is worthy of notice that in *Case* 1, in which the otherwise unfaithful symptom of headache was such a marked feature, incision of the cold abscess was immediately followed by a cessation of the pain. As the operation subsequently showed, the abscess must have communicated with the subdural space by means of the perforations in the bone, so we can assume that it exercised a certain amount of compression on the brain, and that the relief of this was responsible for the cessation of the headache. There are a few cases on record in which the subcutaneous abscess was observed to pulsate, and in another it was possible to reduce the contents of the abscess into the subdural space, showing that this communication is not merely a theoretical possibility. Besides, symptoms of meningeal irritation or cerebral compression in tuberculosis of the skull are not quite unknown, cases having been recorded in which vomiting, convulsions, hemiplegia, and epileptic attacks were observed. But they are rare.

It has been asked what evidence there is to show that the cases operated on as tuberculous are not really syphilitic. The reply is that the problem does not exist for anyone who has had the opportunity of examining the parts at the time of operation. In the syphilitic skull the bone is 'worm-eaten', the periosteum is irregularly thickened, and the sequestra are dense. In the tuberculous skull, on the other hand, we find the bone perfectly smooth right up to the margin of the diseased part; the sequestra, when they exist, are very friable, but more frequently they are represented by perforations containing, at the most, disintegrated bony particles; finally, the periosteum is not appreciably thickened, and at the worst its deep surface is lined with fungous granulations where it lies over diseased bone. Except at the point where a cold abscess may have formed, the periosteum may be said to be normal right up to the immediate neighbourhood of the diseased part.

Treatment.—The local treatment is operative, and only operative. On the other hand, unless the surgeon is prepared to resect considerable portions of the cranial vault he had better leave the case alone, for until the parts are exposed there is no means of gauging the extent of the disease. Timorous, makeshift operations can only lead to disappointing results where radical measures are needed. It is not to be denied that repeated interventions are sometimes necessary; but there is surely something wrong when, as in one published case, no less than thirty-five operations were performed in the course of seven years.

Prognosis.—In these cases this will primarily depend on two circumstances: the co-existence of other tuberculous lesions—more particularly pulmonary—and the progress

made by the cranial disease by the time the patient comes up for operation. It is obvious that the chances of carrying out a radical cure are much more favourable when the disease is circumscribed than when it is diffuse; nevertheless, the invasion of vast areas of skull does not contra-indicate an operation, provided the general state of health is satisfactory. A study of the account of the operations performed in *Case* 1 will show that it is not invariably necessary to resect entire areas of bone, and that, even when our interference extends over a large surface area, considerable portions or bridges of healthy bone are left behind. The gaps which remain between have a surprising tendency to fill up spontaneously.

In any case our prognosis will have to be somewhat reserved. Koenig's series of cases (published by Clemens) is particularly instructive from the fact that it emphasizes the important part played by accessory tuberculous lesions. Out of 16 cases, 12 had accessory lesions, and of these only 2 were alive at the end of ten years. Of the 4 which are described as free from extracranial localizations, 2 subsequently succumbed and 2 remained definitely cured. Delamare and Conor operated on 11 cases with 8 successes. In Pelletier's series of 76 cases treated by operation there are 52 complete cures, 16 deaths, and 8 incomplete cures.

ILLUSTRATIVE CASES.

Case 1.—G. B., age 30, had complained for some time of headache of increasing violence which became so severe by July 18, 1919, that he had to take to his bed. The headache assumed two different forms: in the frontal region slight lancinating pains, and in the occipital a dull and yet very pronounced tenacious pain. A short time before he had undergone a course of antisyphilitic treatment, though the history of this disease is somewhat obscure. Wassermann negative. Raised evening temperature. Profuse night-sweats. Both lungs the seat of tuberculosis.

On Aug. 1, a collection of pus over the right frontal region was evacuated by a small incision over the eyebrow, after which the occipital pain promptly vanished. The pus had a distinctly tuberculous aspect. The wound healed in three weeks. Further collections were opened by another medical man over the right eyelid and right side of forehead respectively on Sept. 1 and Sept. 16. After the latter, a depression was felt on the surface of the bone at a point corresponding to the site of the incision. Throughout August and September the evening temperature was in the neighbourhood of 102° to 103·6°, and the night-sweats continued to be profuse.

Operation 1.—Oct. 6. A large horseshoe-shaped flap was turned down on the right side of the forehead, containing all the tissues down to the bone, exposing purulent granulations and three small perforations of the bone lying close up to the coronoid suture, the highest being about 2 in. from the lowest. A probe introduced in turn into each of these led down to the inner table, and, the necessary inclination being given to the probe, it was seen that these perforations communicated one with the other by means of a tunnel passing between inner and outer tables. Using alternately a Dalgren and chisel we removed the outer table between the perforations so as to form a canal over 2 in. long and ¾ in. wide, the bottom of which was composed of inner table. By probing the edges of this canal a further fistula was found leading towards the middle line, where it ended in a larger perforation ½ in. in diameter, which was exposed by further incision of the soft parts. This fistula or tunnel we also transformed into an open canal. This last perforation was found to lead down to the dura, which was thickened and rough, and did not pulsate. It was thoroughly scraped, but very little came away. A fifth perforation was finally exposed a short distance above the right eyebrow. It was nearly 1 in. in diameter, and corresponded with the depression felt after incision of the third abscess. It contained fungous masses and a few bony particles, and its base was formed by thickened dura. It could not be shown to communicate in any way with the other perforations. Turning our attention to the flap, we found that the deep surface of the periosteum was covered with fungous granulations, but only opposite the perforations, and that these came away quite easily, leaving behind an apparently healthy membrane. The whole wound was now thoroughly curetted and soaked twice with iodine, after which it was sutured up completely. The perforation above the eyebrow was drained through the original small incision made for opening the last-formed abscess.

Through the fistulous opening in the outer corner of the eyelid, left after incision of the second abscess, it was possible to feel rough bone with the probe; but the treatment of this we judged it advisable to postpone. Our horseshoe incision healed by first intention.

Operation 2.—Nov. 17. Transverse incision over outer part of eyebrow down to the bone, by which we exposed a small perforation. A stylet introduced into this led towards the middle line of forehead with an inclination upwards, the fistula running between the two tables and above the frontal sinus. As in the first operation, this tunnel was transformed into a broad canal by removal of the outer table, and this led us almost to the middle line, where our canal culminated in an oval perforation 1½ in. by 1 in. with its long axis placed vertically. It contained a fairly

compact, bulging mass of fungous granulations, on removal of which with scissors and sharp spoon the pulsating dura mater was exposed. The bony margin of this orifice, as in the other perforations, was friable over a very short distance. We removed it with Luer's forceps, thereby considerably adding to the loss of substance. At the lower margin of the orifice the exploring probe slipped easily into a large cavity having bony walls. This proved to be either the right frontal sinus alone, extending well over the middle line, or perhaps the two cavities turned into one by necrosis and disappearance of the dividing wall. It was found to contain fungous granulations, which we removed with a sharp spoon after enlarging the opening from above. The whole cavity was thoroughly curetted and painted with iodine, after which the wound was sewn up completely. Sutures were removed on the seventh day.

When the patient left hospital one month after operation his weight had increased astonishingly; sleep and appetite were perfect; night-sweats had considerably diminished. The frontal region was quite painless on pressure, but unevenness of the bone could be felt, as well as a pulsating depression in the middle line. Six months later he wrote that his general health was perfect, and that he observed a marked improvement in his mental faculties. He added that there was a point along the line of the horizontal scar at which a drop of pus appeared from time to time, and that he would come back to have this treated when he should have nothing better to do. The gap in the centre of the forehead had nearly filled up and no longer pulsated.

Case 2.—A girl of 18 months, with a swelling on forehead and traumatic history dating ten weeks back. Sleep and appetite said to be disturbed, but the child looked healthy enough. The swelling occupied the centre of the frontal region, was about 1½ in. in diameter and reached to root of nose. The skin covering the central part was of a reddish-violet colour, the contents were fluctuating, and at the periphery a raised border could be felt all round, giving, like the subpericranial hæmatomata of children, the impression of a depressed fracture. A small fistulous opening had appeared a fortnight earlier, immediately below the left eyebrow. With a syringe we withdrew obviously tuberculous pus from the swelling, and after this the impression of a bony depression became stronger.

Operation, Oct. 29, 1919.—Horseshoe incision down to bone, by which a flap was marked out which in extent covered that of the swelling. Bone apparently normal, but the periosteum turned down with the flap was lined with fungous granulations, which round the edges were more voluminous, more consistent, and more adherent, thus accounting for the false impression first produced. These granulations were scraped away. In the left lower corner of the wound we found a fistulous track leading to a point on the supra-orbital arch where the bone was roughened. This was well scraped, and the whole wound was treated with iodine. Suture of the whole wound, which healed by first intention. The fistulous opening beneath the eyebrow was closed at the end of a fortnight.

Case 3.—Zolti Joseph, age 8, a gipsy, the subject of multiple tuberculoses of the extremities, presented in addition: (1) In right temporal region two circular ulcers the size of sixpenny pieces connected by a small bridge of skin, both having undermined edges and thin bases formed by bone covered with fungous granulations. (2) A fistulous opening at the outer angle of left eye; the orbital process of the malar bone felt uneven, and the neighbouring part of the temporal fossa was slightly swollen.

Operation 1, May 26, 1920.—The ulcers of the right temporal region were transformed into a single wound by division of the intervening substance, their edges were cut away, and their bases thoroughly scraped. It was now seen that the corresponding part of the temporal muscle had quite disappeared, and that the bone was exposed over a larger area than we suspected. Incision of the lower margin of the wound exposed the remains of the temporal muscle, which was pale and infiltrated. On detaching it and advancing towards the angle between the zygoma and outer margin of the orbit, we came upon a perforation of the bone the size of a sixpenny piece lying over the suture between the squamous part of the temporal and the great wing of the sphenoid. The base of the perforation was formed by dura mater of normal appearance. The perforation was circular, and its lower edge formed by the whole thickness of the skull, which was here quite smooth. On the other hand, the bony margin forming the upper two-thirds of the circumference of the perforation was very thin, and a considerable circular area of bone surface beyond was rough in consequence of the total disappearance of the outer table. The area of inner table thus exposed was bounded above, behind, and in front by a bony ridge formed by the edge of the outer table, and extended over the squamous and sphenoidal regions as a segment of a circle. This also marked the limit of the disease, for the outer table beyond was perfectly healthy. After snipping away the edges of the perforation and curetting the rough bone surface, the whole was painted with iodine.

To sum up, the following were the bone lesions found:—

1. A perforation of the whole thickness of the bone with exposure of the dura mater.
2. A rough exposed surface of inner table extending above, behind, and in front of the perforation, and limited by
3. The edges of healthy outer table, which formed a large segment of a circle lying about one inch from the perforation above, while the horns of the segment ran into, and lost themselves in, the lower margin of the perforation.

OPERATION 2, June 3.—Krönlein's incision on the left side exposed the carious outer margin of the orbit. The orbital periosteum was detached, the external angular process of the frontal bone and frontosphenoidal process of the malar were divided with the chisel, and the diseased part of the outer wall of the orbit was removed with Luer's forceps, thereby putting into communication the orbital and temporal fossæ. The soft parts, including the orbital periosteum, looked healthy. Operation completed by suture of flap and drainage of fistulous opening after resection of its edges.

One month later, when the child left hospital as incurable, the right temporal wound had become again filled with fungous granulations; on the left side the wound resulting from Krönlein's incision had closed by first intention, but the fistula still secreted, and a cold abscess was in process of formation over the zygomatic arch. The extracranial lesions had also progressed.

Although the cranial affection was not treated by operation in our fourth and last case, for reasons which will become evident, the local appearance of the disease was such as to support much of what we have said regarding its pathology, without invalidating any of the opinions expressed. The case is illustrative of the vast areas which may be attacked, and supports the theory that the disease tends to spread in the diploe. We have the best reasons for believing the sequestra to have been formed exclusively at the expense of the outer table, though of course, without exposing the parts by means of an operation, it was impossible to judge accurately of the condition of the inner table. All that can be said is that no perforations, and indeed no obvious disease of the inner table, were appreciable.

Case 4.—A. T., age 38, the mother of two fine girls, had suffered for twelve years from external tuberculosis affecting especially the lower extremities. The wounds had opened and closed repeatedly during this period. When she was seen in February, 1920, the greater part of the left arm and forearm was turned into a vast suppurating wound. An *x*-ray examination showed the shaft of the humerus to be widely diseased. In view of the great pain suffered by the patient and the impossibility of the arm ever becoming of any use, we advised amputation. As the patient was at the same time the subject of advanced pulmonary tuberculosis, we removed the arm at the shoulder-joint under local anæsthesia (April, 1920). A large part of the wound healed by first intention, but the lower portion assumed a distinctly tuberculous aspect, and the process subsequently extended to a considerable area of chest-wall below the shoulder, though it finally healed. In August the patient complained of a painful swelling on the left side of the head, and this soon ulcerated, allowing uneven bone to be felt in the neighbourhood of the antero-inferior angle of the parietal. In the following months small pieces of bone came away, and in February, 1921, the local condition was as follows :—

A lozenge-shaped ulceration, 4 in. by 2½ in., spread over the left side of the head, beginning at a point behind the level of the ear, but higher up in the parietal region, and extending forwards well into the frontal region. Pressure on the thin, undermined edges was painful, and caused pus to ooze out. The base of the ulcer was formed of smooth red granulations lying on denuded bone, and its surface was rendered irregular by the presence of two cup-like depressions, of which the larger measured 1½ in. in diameter. Examination showed these depressions to be due to a loss of substance affecting the superficial layer of bone alone, for a bony basis was everywhere to be felt with the probe.

Separated from the anterior extremity of the ulcer by half an inch of skin was a second ulceration the size of a sixpenny piece, in which rough bone capped with dried-up secretion was visible. The skin of the upper eyelid was also ulcerated, and there was purulent conjunctivitis.

Finally, there was in the centre of the forehead a circular ulcer over 1 in. in diameter, from which we removed with forceps a flat, honeycombed sequestrum over 1 in. long and rather less in breadth, exposing a second layer of uneven bone beneath (inner table).

REFERENCES.

[1] *Clujul Medical*, 1920, Aug.
[2] LENORMANT and SOUPAULT, " La tuberculose de la voûte cranienne ", *Presse méd.*, 1920, 494.
[3] ROGER, *Presse méd.*, 1919, No. 48.

A FURTHER CONTRIBUTION TO THE STUDY OF CYSTS AND PAPILLOMATA OF THE BREAST.

By Sir GEORGE LENTHAL CHEATLE, London.

In two former contributions to this journal I have endeavoured to demonstrate certain pathological changes in the breast epithelium and their relation to 'cystic' changes. In

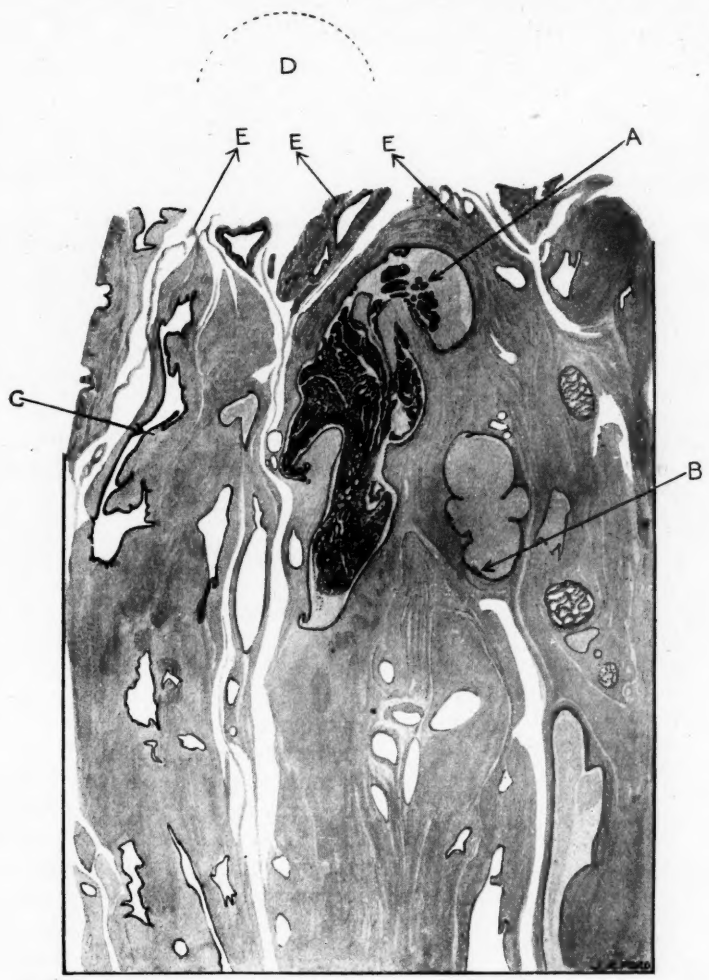


Fig. 213.—Shows a multiradicular papilloma in the ampulla of a duct (A). B is part of another ampulla in which the indicator is pointing to a part of which *Fig.* 214 is a higher magnification. C is a normal ampulla. D is the position of the nipple, and E E E mark the direction of the ducts towards it. It will be noted that there is no collection of chronic inflammatory cells around the tumour-containing ampullæ.

the present paper I hope to make further observations which may serve to indicate the connection between cystic and epithelial changes on the one hand, and the development of new growths of a simple or malignant type on the other.

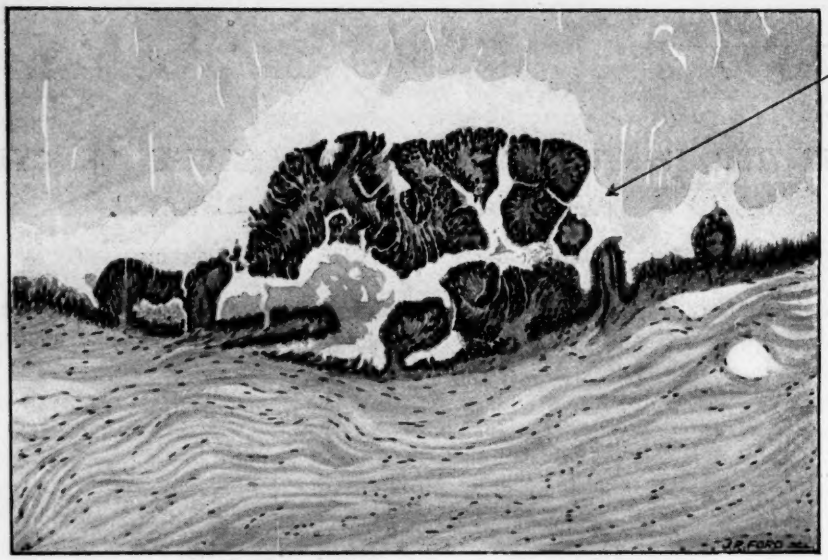


FIG. 214.—Is a high magnification of the ampulla **B** in *Fig.* 213. It will be noted that there is no collection of chronic inflammatory cells outside this ampulla, which contains a multiradicular papilloma (**A**) in an early stage of growth.

FIG. 215.—A portion of a whole section of a breast—it shows two parts of an ampulla (**B**) which is filled by a multiradicular papilloma. At **C**, deeper in the breast, was another ampulla which also contained a multiradicular papilloma. It is not shown in this section. **A** is the nipple. There are no chropic inflammatory cells outside the ampulla **B**.

The gland was kindly sent to me for examination by Mr. Sampson Handley.

PART I.

First, I wish to draw attention to two forms of papilloma in ducts. One is of greater importance, since it is often difficult to determine whether it is benign or malignant.

A.—There is the papilloma with a single fibrous stalk of attachment; on the kind suggestion of Sir Humphry Rolleston I venture to name this form the uniradicular papilloma. The axis of fibrous tissue is usually coarse and comparatively thick, and the unattached extremity may divide into two or more branches. It does not grow large, and rarely exists in a breast as a single tumour. This rare condition is seen in THE BRITISH JOURNAL OF SURGERY, viii, No. 31, *Fig.* 207. Usually its presence is associated with papillomata of the next type; then it is frequently multiple.

B.—For reasons to which I have alluded, the second form of papilloma is the more important. In this there are many stalks of attachment to the duct in which it occurs. On the same kind advice I name this a multiradicular papilloma. The axis of fibrous tissue is most delicate and fibrillous, and its branches are so numerous that they fuse and thus form a network within the duct, which in consequence is much distended (*see Figs.* 213, 214, 215 and 216). Accompanying the papillomatous formation there is to be seen often a marked hyperplasia of the epithelium attached in a sessile manner, in which there is no axis of

fibrous tissue. This papilloma sometimes may occur alone, or more frequently it may be associated with others. In some breasts it may be mixed with the papillomata of the uniradicular form. If strict limitation of the tumour to the duct walls is a sure guide, the tumours in *Figs.* 213, 214, and 215 are benign. The tumour in *Fig.* 216 is malignant; on careful microscopical investigation the duct walls are seen to have been invaded.

There is no inflammation surrounding the ducts which contain the papillomata in *Figs.* 213, 214, and 215. There was intense inflammation surrounding the duct containing the papilloma in *Fig.* 216. The ampulla was undergoing acute suppuration. Pus and blood were being discharged from the nipple when Mr. Corner removed the gland.

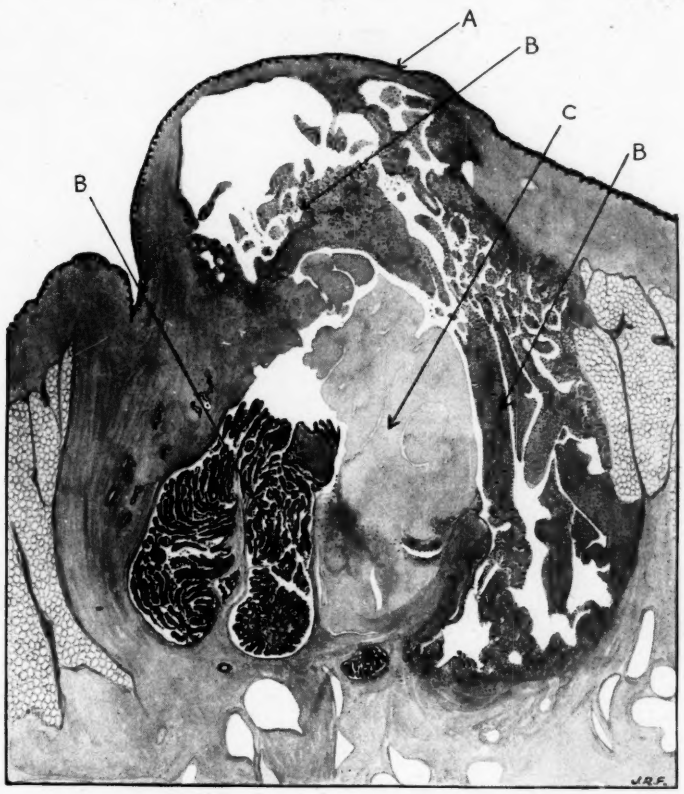


FIG. 216.—Shows a large malignant multiradicular papilloma (B) in a much-distended ampulla. The tumour was acutely infected and was suppurating in most of its parts. C is a large hæmorrhage. The surrounding connective tissue was in a marked state of acute inflammation, and at parts the tumour was invading the walls of the duct. A marks the nipple. The gland was kindly sent to me for examination by Mr. E. Corner.

There is another feature characteristic of the multiradicular type of papilloma besides its close relationship to malignant disease. It is that often it can be demonstrated as originating in the ampullæ of ducts (*see Figs.* 213, 214, 215, 216). In the breast from which *Fig.* 217 is drawn, there are two ampullæ, each of which contains cancer undergoing colloid change. There is too much of this degeneration to enable me to decipher which of the two types of duct cancer the ampullæ contain. The rest of the tumour is mainly 'laciform' in type. The point I want to emphasize is that the ampullæ of ducts have great pathological importance. It certainly appears to me that their contents would be more stagnant than those in other parts of the dilated ducts, and that if these contents contained an irritant the action would remain undisturbed for long periods. Although I consider, for many reasons, that agents of irritation can and do enter the breast through the open ducts at the nipple, yet I am aware of the possibility of stagnant, or altered and

stagnant, secretion also acting as an irritant. As I have said, many things point to the entrance of irritants through the duct orifices; among them is the article by Mr. C. J. Bond in the *British Medical Journal*, March 29, 1913, on "The Mucous Channels and the Blood-stream as Alternative Routes of Infection".

In two previous communications (BRITISH JOURNAL OF SURGERY, 1920, viii, Nos. 30 and 31) I described two types of duct cancer which may remain pure, and indicated that both types might be found in one tumour. These types were the papillomatous and

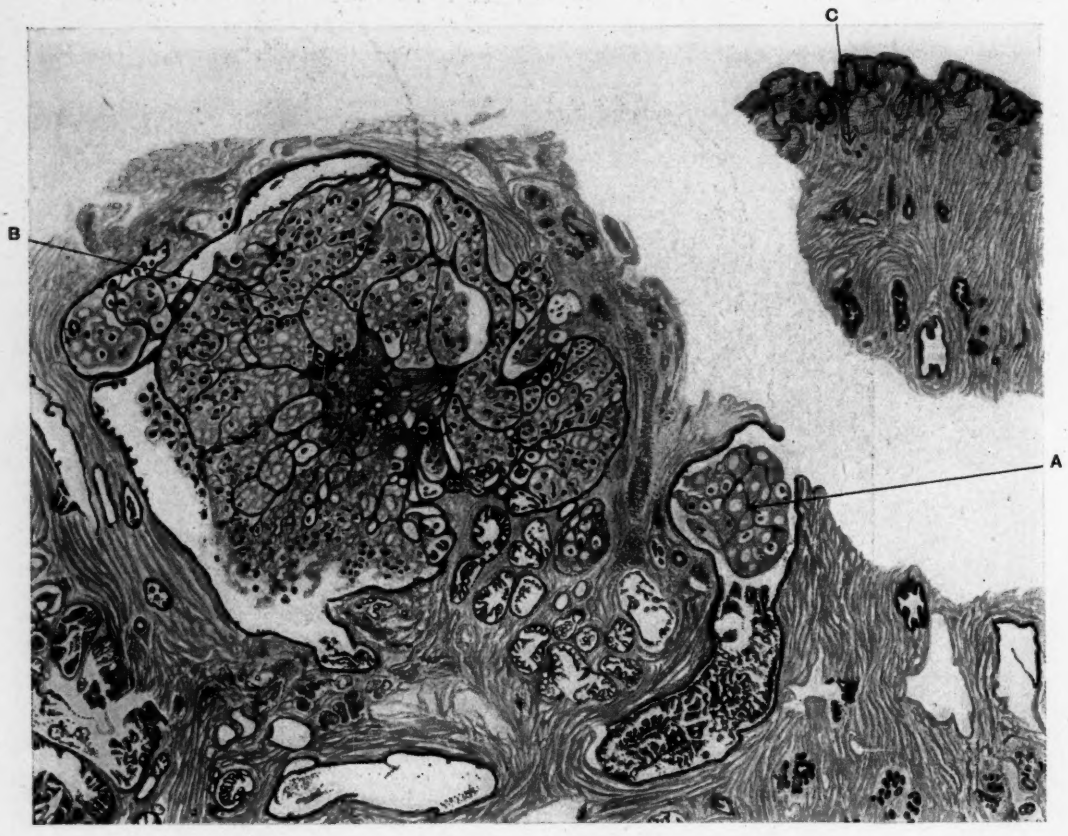


FIG. 217.—A part of a whole section of a breast. It shows two ampullæ (A and B) which contain separate foci of primary cancer undergoing colloid degeneration. The cancer in the ampulla B has invaded the walls of the duct and surrounding tissues. Serial sections showed there was no continuity between the cancer in A and the cancer in B. C is the nipple.

the 'laciform'. Of the two, the papillomatous was the less malignant, but the 'laciform' and mixed duct cancers were capable of being the most malignant seen in breast cancer. Dr. Archibald Leitch, in a short illuminating article (*Archives of the Middlesex Hospital*, 1908, p. 80, "On Secondary Malignant Conversion of Epithelium"), pictures the 'laciform' condition in a duct, and definitely shows that a comparatively extensive surface of epithelium has taken part in the primary cancer process. Dr. Leitch's article should be read by all who take an interest in cancer. Before publishing my two papers in this journal I was unaware of Dr. Leitch's original observations; otherwise I would have drawn attention to them.

PART II.

The condition of breast epithelium to which I pass on to refer, is clarified by the examination of whole sections cut from three breasts. The breasts were removed from

FIG. 218.—A whole section of half a breast which was removed on account of the large macroscopical cyst (A) it contained. B points to that part of the breast from which the duct A in *Fig.* 219 is drawn. Many smaller duct cysts can be seen in the drawing.

three different individuals. The condition was characterized by a diffuse, benign, desquamating hyperplasia of epithelium in ducts and acini around which there was no sign of chronic inflammatory changes. I am convinced the condition to which I refer is primary

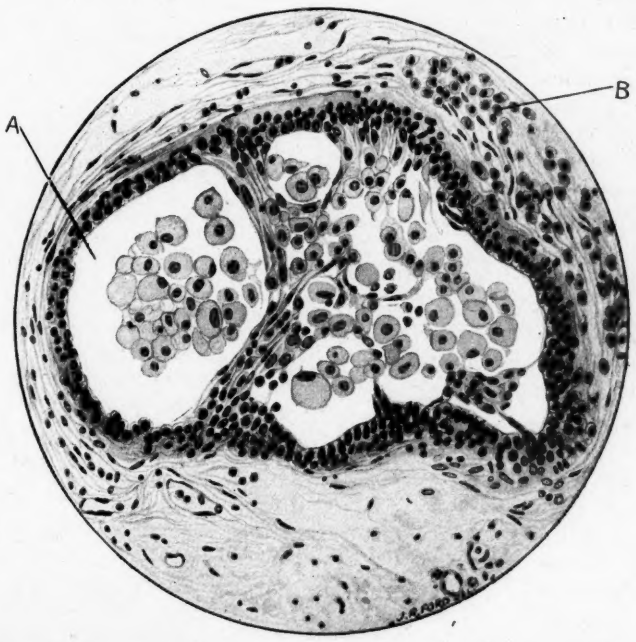


FIG. 219.—A drawing of a small duct (A) from B in *Fig.* 218. The epithelium can be seen undergoing desquamative hyperplasia at five or six different points. The cells undergoing hyperplasia soon become longitudinal and desquamated after becoming large round degenerated cells. These desquamated cells fill and distend the duct. The contents appear clinically as white thick fluid. The fibrous tissue outside the duct at B shows slight local proliferation. There are no leucocytes at this or any other part. The proliferation at B is secondary to distention of the duct.

within the gland ; it may be due to an irritant, but it is not secondary to chronic inflammatory changes outside the epithelial structure. I regard the chronic inflammatory

changes which so often are associated with it as secondary. I cannot conceive that such localized and infrequent and small foci of chronic inflammation, however intense it may be, can be the cause of so diffuse a hyperplastic change.

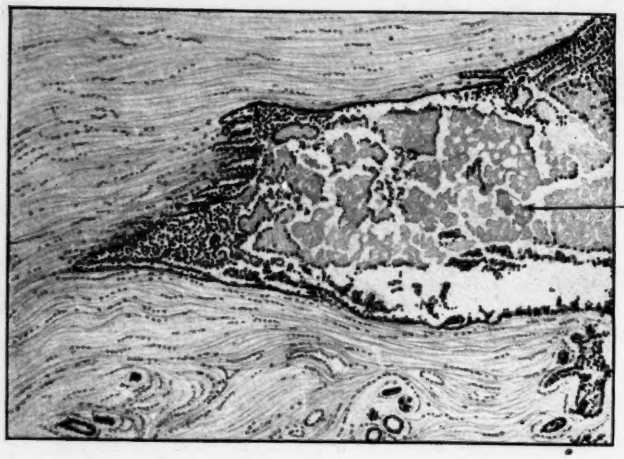


FIG. 220.—A drawing of a large duct (A) from another breast in which the duct has become distended as the result of desquamative hyperplasia of the epithelial lining. There are no leucocytes outside this duct, nor were there any leucocytes outside any of the ducts in this breast, although it was diffusely affected by epithelial hyperplasia.

There are many reasons for thinking as I do; among them are the following: In many parts where there is no hyperplasia of epithelium, chronic inflammation is most marked (*Fig.* 222). In the three breasts to which I am now in a position to refer, there is no chronic inflammation to be seen anywhere in the course of the ducts and acini which contain the hyperplasia of epithelium. And in other breasts where the epithelium is undergoing this desquamative hyperplasia in a duct that is locally more or less surrounded by chronic inflammation, the hyperplasia is often least marked where the inflammation is greatest. I need not labour the point.

Clinically, the condition in some breasts is marked by their containing cysts or only one palpable cyst. I shall point out later that I am convinced these cysts are determined by the distention caused by the diffuse hyperplasia of the glandular epithelium. In other breasts the condition is masked by small nodules universally distributed over the whole glands. In yet others, only a segment of a breast may be thus affected, indicating perhaps that a duct and its distribution is the main part that is undergoing the change. The nodules are mainly the dilated ducts. The distention of the ducts is the cause of the pain.

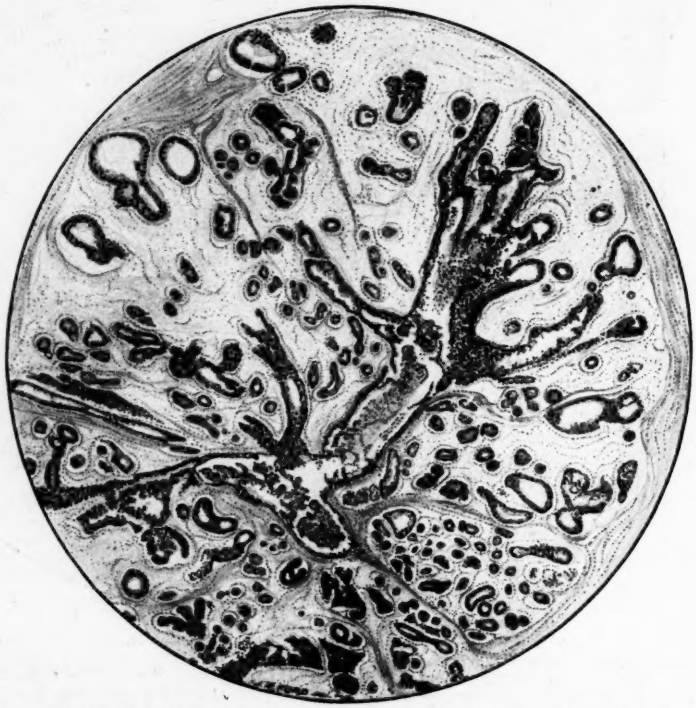


FIG. 221.—A drawing from a terminal duct and its branches. The duct, and some of the acini into which it leads, are seen to be undergoing desquamative epithelial hyperplasia. There are no leucocytes outside or inside the gland cavities of this and the preceding breast. There are no leucocytes present in any part of whole sections made from this breast.

Microscopically, the condition is seen to be a hyperplasia of large tracts of ducts and some of the acini into which their terminal branches lead. The hyperplasia of epithelium can be seen

in its earliest stage in a transverse section of a small duct in *Fig.* 219, which is taken from part of the cystic breast, *Fig.* 218, B. The epithelial cells at five or six different places have proliferated and become longitudinal in shape. Early desquamation is obvious. The large round desquamated cells are typical contents of ducts. I have not seen them in acini. There are no lymphocytes in the tissues outside this duct at B. There are a few connective-tissue cells that have proliferated. It is impossible to conceive that a dilating distended duct, as this is, could undergo these changes from the normal size without inducing some action on the part of the surrounding tissue. The changes in the surrounding tissue are, I believe, secondary to the duct changes. Similar intra-glandular changes can be seen in *Figs.* 220 and 221. *Fig.* 220 is a duct that is reaching the cyst stage. *Fig.* 221 is the termination of a duct in the same process, but not so advanced; some acini into which it leads have escaped sharing in the process. There is no sign of chronic inflammatory changes outside the ducts and acini of this breast, from which *Figs.* 220 and 221 have been drawn. Although an irritant stagnated within the duct is probably the cause of the epithelial hyperplasia, to term the condition 'chronic mastitis' or 'parenchymatous mastitis' is, in my opinion, erroneous. I would

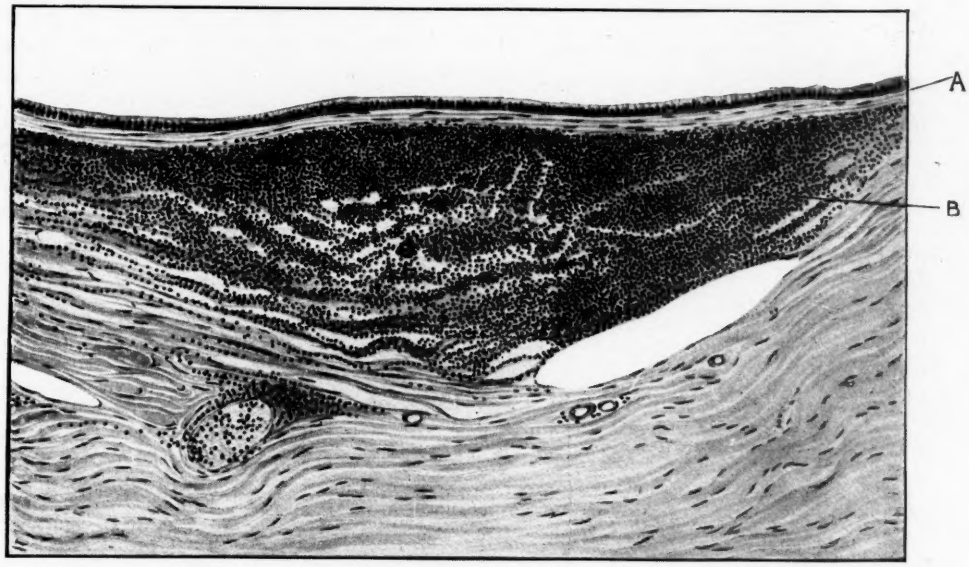


FIG. 222.—A high-power drawing of one margin of a longitudinal section of a duct. The epithelium (A) is normal. The tissues outside the duct contain a collection of lymphocytes (B), among which are some polynuclear leucocytes.

prefer to call it a diffuse benign desquamative hyperplasia of breast epithelium. I regard it as a cause of cyst formation. Papillomata are absent in the three cases under observation; these may complicate the condition, but they are not an essential part of it.

This diffuse desquamative hyperplasia is seen frequently in the epithelium of fibro-adenomata of breasts. It is also to be observed in many breasts where cancer is present. I look upon the condition as pathological.

In future it is probable that the course of events may be stated in the following way: When cysts are once formed they may predispose to further pathological changes which otherwise would not have occurred. The cystic stage may lead to distention and stagnation, which would favour the continued undisturbed action of an irritant. This in turn might serve as the direct prelude to further changes, probably resulting in what is commonly regarded as a simple or malignant tumour. Our present ignorance of the cause and limitation of epithelial hyperplasia prevents the immediate and complete acceptance of this fascinating theory. On the evidence before me, all I can say is that I do not believe that the tumours described here would have arisen if the cystic state had not in some way acted as a predisposing and determining cause of their initiation and growth.

RECONSTRUCTION OF ANKYLOSED KNEE-JOINTS.

By Sir W. I. de COURCY WHEELER, Dublin.

Opinions are divided as to the relative merits of arthroplasty and excision in the treatment of many stiff and diseased joints. In certain cases the indications for one or the other are comparatively clear. The pendulum has swung rather back towards excision in the case of the elbow-joint; both operations yield satisfactory results in the case of the shoulder, but, in ankylosis of the hip, stability is so essential that, if a mobilizing operation is indicated (a rare contingency), most surgeons will prefer arthroplasty to excision.

There is almost unanimity of opinion concerning the knee, namely, that sound ankylosis in the great majority of advanced cases is the only desideratum. Reconstruction of an ankylosed or diseased knee-joint with a view to the restoration of movement has been summarily dismissed by many authorities as an operation based on unsound principles and rarely followed by success. The following case

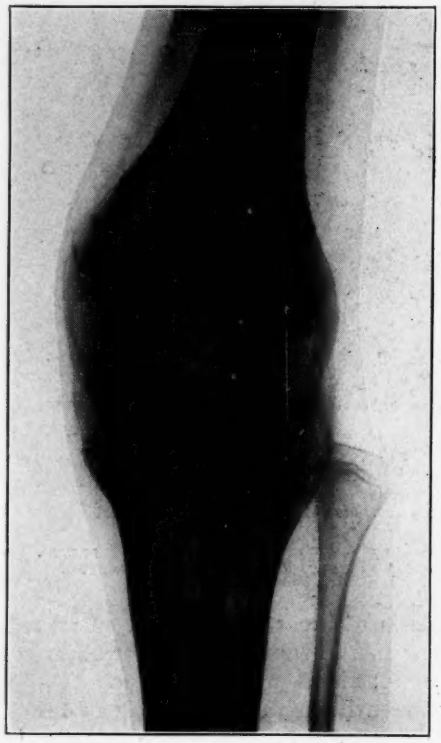


Fig. 223.—Right knee-joint, ankylosed in extension.

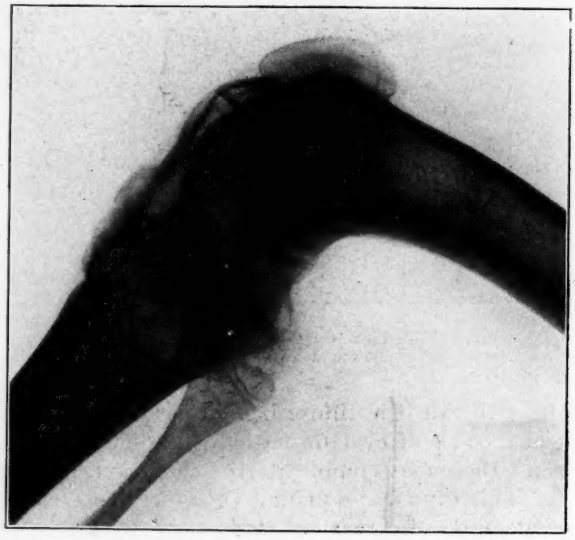


Fig. 224.—Left knee-joint, ankylosed in flexion.

is reported to illustrate that this condemnation, although justifiable in a general way, has been too emphatic, and that in certain cases success may be anticipated:—

In August, 1919, a little girl, age 11, gave a history of acute osteomyelitis of both tibiæ, a prolonged illness, and frequent operations. Numerous scars, the result of healed sinuses and operation wounds, were in evidence down the front of both shins. Both knee-joints were firmly ankylosed. The left knee was ankylosed in flexion, the right in extension. *X*-ray photographs showed firm bony ankylosis, with destruction of the epiphyses of the femur and tibia, on both sides (*Figs* 223 and 224).

The parents were told that the general opinion of surgeons was against operation, that lateral stability could not be ensured, and that in the absence of crucial ligaments it was difficult to prevent the tibia rocking backwards and forwards on the femur. Lateral mobility, and forward and backward play of the tibia on the femur, with a want of check on inward rotation of the tibia, might render the knees so insecure that walking without aid might be quite impossible. These were the orthodox arguments against operation. On the other hand, it was pointed out that much could be done in the remodelling of the bones at operation to promote security for weight-bearing, and that the formation of a capsule and ligaments might be expected in time, such as is seen surrounding a false joint, the result of an old ununited fracture of the long bones.

In September, 1919, an operation was performed on the left (flexed) knee, after the manner recommended by the late J. B. Murphy. An incision was made about 4 in. long on either side of the patella, slightly curved with concavity backwards. The skin was reflected freely, and two tongue-shaped flaps of fat and fibrous layer of the capsule were fashioned, the base of each flap being downwards, attached over the internal and external

FIG. 225.—Both knee-joints in extension after operation.

surfaces of the upper extremity of the tibia. A Jones gouge was easily driven through the new bone binding the femur and tibia, and the knee was fully flexed. The lower end of the femur and the upper end of the tibia were cleared of all irregular bone, and both surfaces fashioned to leave as large an amount of bone in a lateral diameter as possible, and thus diminish the tendency to lateral instability. A mortise in the form of a substantial groove (not well shown in the skiagrams) was made from front to back on the surface of the femur, and a corresponding tenon cut in the tibia to limit the lateral gliding of the one bone upon the other. Care was taken to remove slightly more bone from behind in order to diminish any tendency to hyper-extension. The flaps were now placed loosely across the upper end of the tibia and fixed by a few points of suture in position.

The extensor apparatus was unduly lax when the flexed joint was brought into the

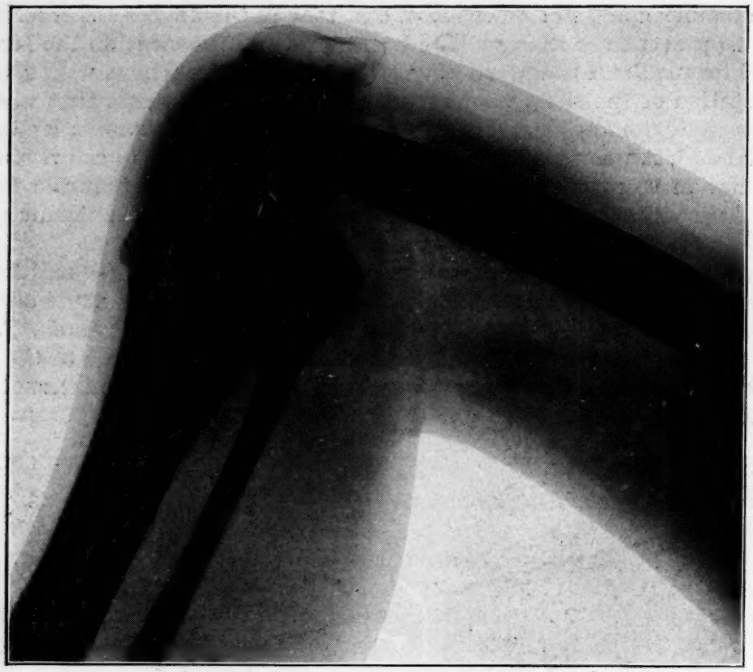


FIG. 226.—Showing amount of voluntary flexion in left knee-joint 2 years after operation. Note the patella 'turned turtle'.

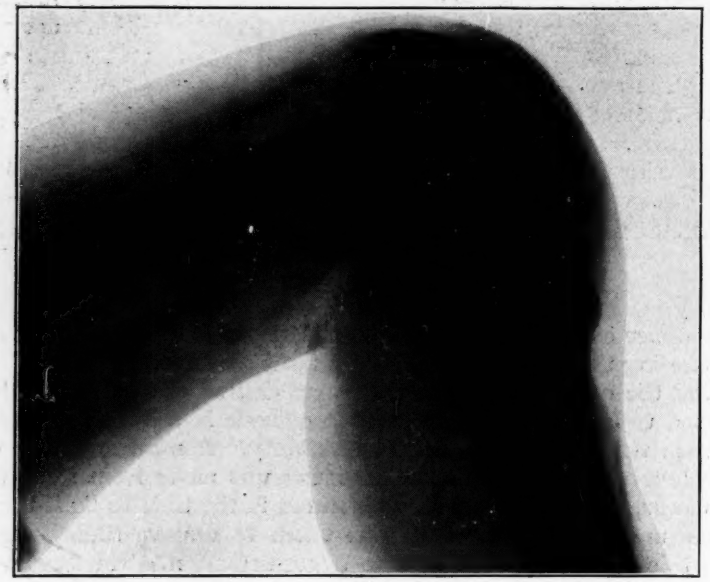


FIG. 227.—Showing amount of voluntary flexion in right knee-joint 18 months after operation.

straight position, and the patella was 'turned turtle' with great ease—a manœuvre which prevents subsequent fixation to the front of the femur.

There was little or no pain after operation, and the stitches were removed after eight days. The leg was immobilized on a simple back splint.

After removal of the stitches the child was encouraged to move the joint actively as far as possible as it lay unbandaged on the splint. There was a striking absence of pain. The knee moved actively a few degrees in flexion and extension after the first dressing. The child gave this demonstration to every visitor, until, in an astonishingly short time, voluntary flexion of the joint to half a right angle was possible. Great care was taken to prevent any movement in a lateral direction. Massage and passive movements were employed after the first fortnight to hasten the development of the wasted

FIG. 228.—Snap-shot photograph of left knee, child walking.

FIG. 229.—Snap-shot photograph of right knee, child walking.

quadriceps. The child was discharged two months after operation on a calliper splint jointed at the knee. She could walk now with easy voluntary flexion of the left knee to about half a right angle and without pain.

The absence of pain on either active or passive movements interested me, for to this phenomenon the success of the operation is in a large measure due. The child regarded the after-treatment from the start as being something in the nature of a game, and worked hard in her efforts to give satisfaction and surprise as we daily watched the return of the joint to something approaching normal.

The absence of pain after operation is due probably to the removal of any remains

of the old lateral ligaments and capsule of the joint which carry the sensory nerves.* Murphy states that, in addition to affording a wider range of motion in the new joint, removal of the ligaments together with the capsule also obviates one of the causes of post-operative pain. I cannot think of anything more important to obtain a good result in arthroplasty operations than prevention of pain. The early after-treatment is simplified a hundredfold.

Six months after the first operation the patient was re-admitted into the private hospital, and a similar operation undertaken on the second knee. The joint on this occasion was straight and not flexed, and the operation was rendered more difficult in consequence. The quadriceps extensor tendon and the patellar ligaments were tense, and the patella could not be turned turtle as in the previous instance. A flap was fashioned and inserted between it and the femur in addition to the main intra-articular flap.

The after-treatment was modified and improved upon. Extension was maintained by means of a Thomas knee bed-splint which was daily loosened for massage and active movements. As before, there was no pain, and the child co-operated admirably with the efforts to promote movement and develop the muscles.

Two months later she was discharged, still wearing a jointed calliper splint on the left leg and a jointed leather moulded splint from groin to ankle on the right.

She presented herself for examination two years after the first operation and eighteen months after the second. She is walking freely without splints or crutches, and but for a slight forward bend of the body, a habit contracted to obtain better equilibrium, her gait is to the ordinary observer almost normal (*Figs.* 228, 229).

Sir Robert Jones saw the patient in the early stages of treatment when he was visiting Dublin.

She was exhibited at the Royal Academy of Medicine in Ireland, and, when asked to hop across the room, did so with agility. There is a little lateral mobility, but not more than is often seen following stretching of the ligaments after prolonged effusion or extension in the treatment of injuries. In this connection Murphy states: "In the early days of our arthroplasty work we felt that something serious would happen if we totally removed the articular ligaments. As time went on, however, I learned that large ligaments developed about the site of a pseudarthrosis". This statement is probably correct. If no movement is allowed in the lateral direction during repair, there will be a corresponding condensation of the connective tissues on each side. On the other hand, movements are secured in desired directions from the earliest moment. Connective tissues trained in this way eventually take on the form and function of ligaments.

The object of this communication is not to advocate the operation of arthroplasty of the knee-joint, but to show that under favourable circumstances, when there are real indications for the operation, there is a reasonable prospect of success.

I have to thank Sir Robert Jones for his kindness in examining this case when on a visit to me in Dublin, Professor A. F. Dixon for information about the nerve supply of joints, and Dr. Garratt Hardman for the trouble he took in connection with the *x*-ray plates.

---

* Ligaments receive nerve fibres both sensory and vasomotor. The nerve fibres always come from the same nerves that supply the muscles moving the joint and supplying the overlying skin (Rudolph Fick).

RECONSTRUCTION OF THE SHOULDER.

By Sir W. I. de COURCY WHEELER, Dublin.

The operative possibilities in cases passing through hospitals for disabled pensioners, as time goes on are becoming less and less. During the three years since the War the majority of the patients have been operated on once or many times, and a halt has been called in most cases to all but purely non-operative orthopædic methods of treatment. There are cases still which are admitted for conditions of non-union, mal-union, and cross-union of bones capable of repair, but they are rare.

The same applies to joints, nerves, and muscles, although here, too, some cases appear to have drifted from one place to another without the obvious rational operative treatment having been tried.

The following case illustrates the last statement :—

A pensioner, aged about 25, was wounded in November, 1918, by a high-explosive shell. The right shoulder below the acromion process was carried away *en masse*, skin, muscles, and bone, leaving only a pedicle on the inner side carrying the main vessels and nerves by which the arm hung helplessly to his side. The wound was septic and unhealed for eighteen months.

On admission, dense cicatrix occupied the right deltoid region. The area of the scar extended backwards over the lower scapular region, and forwards over the insertion of the pectoralis major muscle (*Fig.* 230). The movements in the hand were strong and free. All the muscles of the upper arm were out of action; nevertheless he could flex and extend the elbow with considerable strength. This trick was accomplished by fixing the extensors and flexors of the forearm below and contracting them on their attachment to the condyles of the humerus, thus producing flexion and extension of the elbow and an excellent mimicry of the normal action of the biceps and brachialis anticus muscles. *Fig.* 231 shows a skiagram taken at this time.

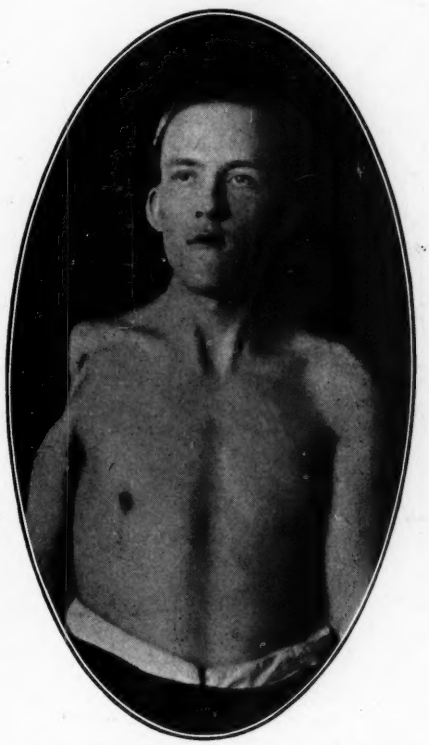


FIG. 230.—Pensioner K. Wounded 1918. The right arm is seen hanging from the trunk by a pedicle containing the vessels and nerves. The skin, deltoid muscle, and upper end of the humerous were blown away.

The patient had been told so often that nothing could be done to restore the shoulder and upper arm, that consent to operation was only obtained on condition that it was completed in one stage.

The scar was subjected to massage, radiant heat, etc., in the hope of lighting up any latent sepsis, if such existed, before a major operation was attempted.

Operation, April, 1920 :—

1*st Stage*.—Two incisions were made, one just below the acromion process, extending forwards under the clavicle and backwards beneath the spine of the scapula, above the cicatrix. The second skirted the cicatrix below at the level of the middle of the shaft of

the humerus. The incisions met in front and behind so as completely to encircle all the scar tissue. The dissection was slow and tedious, as the scar (the result of old sepsis) had penetrated deeply in the position corresponding to the shoulder-joint. After removal of the scar, a deep hiatus was left between the acromion process and the upper end of the fractured humerus; the arm hung like the sleeve of a coat from the inner flap containing the vessels and nerves.

2nd Stage.—The upper end of the humerus was cleared and divided until healthy bone appeared, and all irregularities were removed. The glenoid cavity was exposed and an effort was made to freshen the surface.

3rd Stage.—A bone-graft 9 in. long was removed from the inner surface of the right tibia with the Albee twin saw, regulated so as to cut a graft of tight fit for the medullary cavity of the humerus. The graft was driven tightly into the humerus for four inches. The arm was abducted and held in position so that the graft lay along the glenoid cavity, the upper extremity touching the acromion and coracoid processes (*Fig.* 232). The intention was to obtain a broad union between graft and scapula with the arm in slight abduction.

FIG. 231.—Skiagram of patient on admission, showing absence of upper end of the humerus.

4th Stage.—Five inches of the graft lay bare, with no skin, muscle, or other soft tissues for a covering. To remedy this a plastic operation of some magnitude was necessary. A large pedicled skin-flap was fashioned from the front of the chest, and the skin above and below the original incisions freshly undermined. A skin covering was obtained, but it was obvious that this was insufficient for the graft, although ample so far as the wound area was concerned. It was decided to replace the destroyed deltoid muscle by transplantation of the clavicular portion of the pectoralis major outwards as described by Elmslie. The attachment of the muscle to the clavicle was separated subperiosteally, and the clavicular portion isolated from the sternal. The tendon attachment was severed, so that now the muscle lay quite free but for a pedicle which contained the vascular and nerve supply. The detached muscle was swung outwards over the bone-graft, and attached to the acromion process and clavicle above by a few points of suture. Below it was sutured to the periosteum and soft tissues round the humerus in about the position where the normal deltoid is inserted.

The clavicular portion of the pectoralis major has successfully replaced a deltoid destroyed by injury, good abduction of the arm resulting; but in the present case, as ankylosis of the bone-graft with the scapula was aimed at, the muscle-graft was used merely to give ample covering to the bone.

The skin flap was now sutured in position and the undermined margins were brought into line. The operation occupied two hours.

The arm was carefully immobilized on an abduction splint. The stitches were removed in a fortnight, and the splint was replaced by an extensive plaster casing.

For three months rigid immobilization was insisted upon, as is the custom, and afterwards slight stresses and strains were permitted in conjunction with massage and active movements to stimulate growth in the graft.

The behaviour of the bone-graft in this case illustrates many interesting points. The growth is seen in the photographs taking place at the side of the graft remote from the periosteum. The skiagram taken three months after operation (*Fig.* 233) demonstrates a condition which gives rise to anxiety in many grafting operations about this period. There is a mottled irregular appearance in the portion not directly contacted with bone, and an alarming loss of density. It is difficult to foretell at this stage whether the graft is about to crumble and become absorbed, or whether appearances are deceptive and the loss of density is due to the fact that at first the demolishing powers of the osteoclasts are more apparent in the photographs than is the reproducing capacity of the osteoblasts. It must be assumed that the activity of both classes of cells goes on simultaneously in successful cases, the osteoblasts inserting a new brick in the structure as the old ones are removed *pari passu* by the osteoclasts. Sometimes, however, in the grafts that fail, osteoblastic action is absent, and this cannot be told by *x* rays, for bone-formation in the embryonic stage is translucent and does not cast a shadow.

FIG. 232.—Skiagram taken immediately after operation; four inches of the graft is intramedullary, the upper portion is in contact with the glenoid cavity, the coracoid, and the acromion.

The photograph taken six months after operation dispelled anxiety, for now a buttress of dense new bone could be seen on the medullary side of the graft and the density of the whole had considerably increased (*Fig.* 234). The increase of density and thickness was confined to the portion of the graft bearing stresses and strains, namely, between the upper end of the humerus and the glenoid cavity. There was firm ankylosis at these two points.

Thickening of the portion of graft inserted into the humerus, and also of that portion above the glenoid cavity, is seen in the second photograph, where stresses and strains, if any, were distributed over the whole graft; but after ankylosis had occurred at the glenoid and the extreme upper end of the humerus, the intramedullary portion and the portion above the glenoid were inert, and absorption is taking place, especially below. More active movements and a more general use of the arm were allowed later, and with the movements of the scapula some strain was evidently transmitted to the portion above the glenoid, which became more solid and dense. The graft below united beautifully to

the upper end of the humerus, and there was no further use for the intramedullary portion, which is seen attenuated and about to disappear (*Fig.* 235).

The condition of the patient before operation is well shown in *Fig.* 230, and fourteen months after operation the patient is shown (*Fig.* 236) holding a vessel weighing 5½ lb. at arm's length during a time exposure. He can use his arm freely, and almost place his hand to the back of his head. The scapular movements are increasing in range, and the muscles of the upper arm have recovered.

FOURTEEN POINTS ABOUT BONE-GRAFTS.

1. A loss of density apparent in a graft as shown by *x*-ray photographs a few weeks after operation is deceptive, and does not necessarily indicate absorption and failure. In the early stages the demolishing activity of the osteoclasts may be more apparent than the bone-producing power of the osteoblasts.

FIG. 233.—Skiagram 3 months after operation—'the period of anxiety'. The loss of density in the graft due to the distinctive powers of osteoclasts is more apparent than the regenerative osteoblastic process at this date.

2. The final success of bone-grafting depends upon the operation of Wolff's law, that is, the graft, stimulated by strains and stresses, changes its internal architecture and external conformation until the required strength is attained. In other words, "the amount of growth in a bone depends on the need for it" (Murphy).

3. To provide the necessary strains and stresses, it is advisable to allow the graft to functionate after preliminary fixation for about three months.

4. The periosteum should be left on the graft, because, although not essential, it is the medium through which new blood-vessels enter the graft and the surrounding structures. Furthermore, in removing the periosteum, superficial layers of osteoblasts may be sacrificed even in an adult. A periosteum-covered graft is therefore less likely to become absorbed.

5. In old ununited fractures with false joints the bone in the 'critical area' (near the site of fracture) is sclerosed and non-vascular, and makes unsuitable soil for that portion of the graft in contact with this area.

6. In such cases a graft, instead of exhibiting osteogenetic powers and responding to Wollf's law, may become attenuated and absorbed, or break in the critical area five or six months after operation.

7. In the same class of case very prolonged fixation is particularly unfavourable to osteogenesis, to the establishment of blood-supply, and bony union. Early movements and the bearing of mechanical stress and strain, on the other hand, may lead to yielding of the graft and failure. The problem is a difficult one in the case of the humerus or femur, where strength is essential. Wide resection of the sclerosed bone, with resignation on the part of the patient to a short limb, is the only remedy when non-operative methods fail.

FIG. 234. — Skiagram 6 months after operation. There is firm union at the upper end of the humerus and at and above the glenoid cavity. Between these points the graft, in accordance with Wolff's law, has increased considerably in girth and density. The intramedullary portion is becoming absorbed.

FIG. 235.—Skiagram 9 months after operation. The graft has replaced the upper end of the humerus. The intramedullary portion, to which no strains or stresses are now transmitted, has almost disappeared. There is firm union with the scapula.

8. A graft must not be used to span a gap in the humerus or femur—it breaks or absorbs. The freshened ends of the fractured bone must be in apposition, and the graft used as a support. This does not apply to grafting of the radius and ulna, nor when a graft is used to replace entirely the lost extremity of a bone.

9. But for slightly slower osteogenetic powers the intramedullary peg is effective. This method of bone-grafting is satisfactory and simple in practice, although faulty in theory (*Fig.* 237).

10. The bone-graft has inherent bacteria-resisting properties: sepsis does not necessarily mean loss of the graft.

11. Absolute fixation of the graft in its bed for about three months, secured either as part of the operation, or afterwards by splints or plaster, is essential to success.

12. Bone-grafting for spinal caries is followed by more uniformly successful results in adults than is seen elsewhere. This is to be expected, since both the graft and the recipient bed (in the region of the spinous processes) consists of healthy bone.

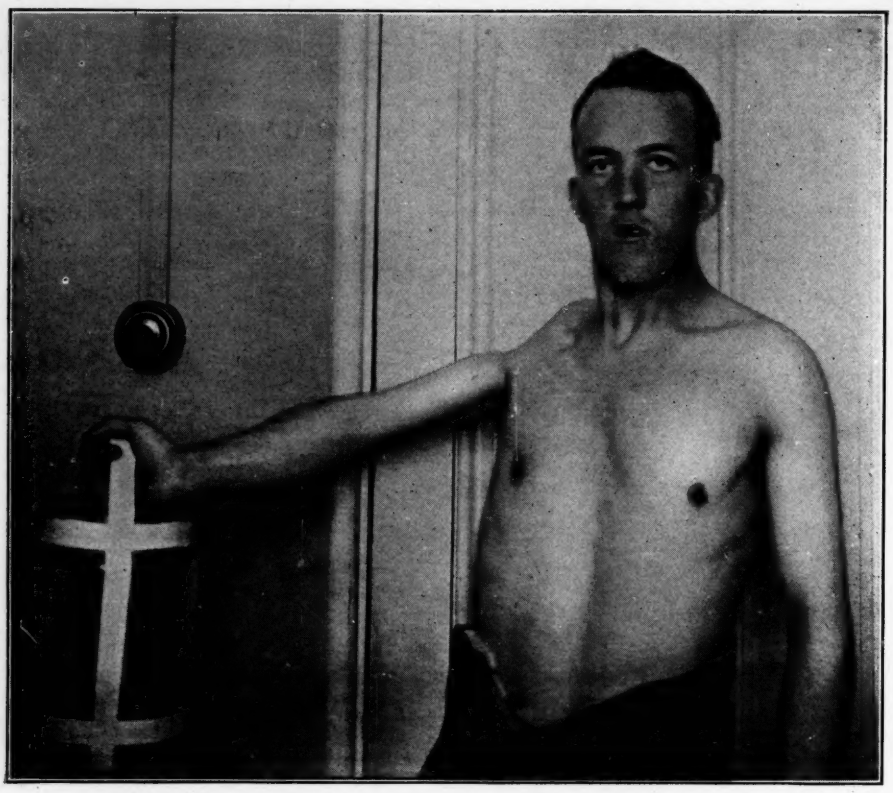


FIG. 236.—Patient 14 months after operation holding a vessel 5½ lb. in weight at arm's length for a time-exposure photograph.

13. As in the operation of tendon transplantation and nerve suture, the operation of bone-grafting should be preceded by correction of any existing deformity and by the freeing of adhesions in neighbouring tendons and joints.

FIG. 237.—Section of humerus showing peg graft introduced six months previously. Note the firm incorporation of the graft with surrounding bone.

14. Identical grafts behave differently in apparently similar cases, and no emphatic prognosis can be given for many months.

BRONCHOBILIARY FISTULA.

By ARTHUR H. BURGESS, Manchester.

Instances of bronchobiliary fistula being of sufficiently rare occurrence to justify the publication of every case observed, I take this opportunity of reporting the following case recently under my care :—

Annie D—, age 59, office clerk, was admitted to the Manchester Royal Infirmary on May 5, 1921, with a complaint that for the previous five months she had been constantly coughing up bile. Her history was that on Dec. 2, 1920, while walking home from her office, she had a sudden attack of coughing and expectorated some thick white phlegm : this recurred frequently during the next three days, and on Dec. 5 she noticed the expectoration was of a yellow colour and left a bitter taste in her mouth. With the exception of a few short periods of two or three days each, during which the sputum was white, frothy, and devoid of any bitterness, she has expectorated daily a frothy yellow fluid, varying in quantity from ten to twenty ounces, up to the time of her admission. Her sputum had been sent for examination to the Manchester Public Health Laboratory, and Professor Delepine had reported it to be pure bile, without pus-cells, blood-cells, or tubercle bacilli ; on culture the *B. coli* was obtained ; on one occasion a few fragments of food particles were observed microscopically, most probably derived from the throat or teeth. At first she denied previous illness of any kind, and even when carefully questioned after operation, in view of the operative findings, all she could recall was that some four and a half years ago she had a headache, with some vomiting of bile, which kept her from her work for a day and a half only : no history of abdominal pain or repeated digestive disturbances could be elicited. She had never been jaundiced, had never noticed any alteration in the colour of her urine, and though of late her stools had sometimes been rather paler than usual they had never been markedly pale. At the commencement of her illness she had lost weight considerably, but for the last three months her weight had remained fairly constant. She had never been abroad.

On physical examination of the abdomen and chest, nothing abnormal was found. No localized tenderness or swelling could be detected even on deep pressure under the right costal margin or elsewhere, the liver was not palpable, and no cutaneous hyperalgesia could be anywhere elicited. She was radiographed on four occasions, but no definite abnormality was noted ; once the left half of the diaphragm was thought to move through a less range than the right, but this was not confirmed on subsequent occasions. Radiographic screen examination after a bismuth meal showed some atony of the stomach with some dilatation of the first part of the duodenum, but there was no delay either in the emptying of the stomach or in the passage through the intestines : the cæcum appeared normal. The urine was clear, acid, sp. gr. 1010, and free from sugar, albumin, bile, and blood. The expectoration varied in colour from yellowish-green to bright yellow, was alkaline in reaction, and frothy ; it was coughed up in quantities of about one drachm every ten to twenty minutes, and the frequent coughing allowed her very little rest at night.

To sum up : an elderly female, apparently in good health and without any previous illness of note, suddenly commenced without any obvious cause to cough up bile, and has continued to do so in amount from 10 to 20 ounces daily for the past five months. Physical examination failed to reveal anything definitely abnormal. A diagnosis was made of 'broncho-biliary fistula' of unknown origin, nor was it known with which lung the fistula was connected. The patient herself stated that she had a sensation as if the phlegm came from the lower and front part of the left side of the chest. Bronchoscopy was considered as being likely to elucidate this point, but as its use would, in her nervous condition, have necessitated an anæsthetic, it was put aside. As the condition had shown no tendency to

spontaneous improvement, and the patient was getting rather exhausted from the frequent coughing and loss of rest at night, exploratory laparotomy was advised and accepted.

Operation, May 28, 1921.—Under ether anæsthesia, administered by the intratracheal method by Mr. S. R. Wilson, the abdomen was opened through a right paramedian incision, the fibres of the rectus being split vertically. The gall-bladder was found contracted, thick-walled, and deeply placed under cover of the liver, which was not enlarged ; calculi were felt in the gall-bladder and in the dilated common bile-duct. There were no adhesions about the upper surface of the right lobe of the liver, but that of the left lobe was everywhere adherent to the diaphragm, as were also the cardiac portion of the stomach and the spleen. Better access was obtained by the transverse division of the upper end of the right rectus, and it was then possible, but with considerable difficulty, to free the upper surface of the left lobe of the liver. The extremity of this lobe was inseparably incorporated with a rounded swelling, about the size of a golf ball, having walls of stony hardness ; it was densely adherent to the diaphragm above, the spleen behind and to the left, and the lesser curvature of the stomach almost as high as the cardiac orifice. On chiselling through the calcified wall of this swelling, some bile and a quantity of ' biliary mud ' escaped. The dense adhesions between the swelling and the stomach, spleen, and diaphragm were then divided, mostly with the knife, keeping close to its calcified wall ; so firmly incorporated, however, was it with the liver that the extremity of the left lobe was excised along with it in a V-shaped form, the sides of the gap being approximated with catgut sutures. The raw surfaces left on the stomach and spleen were peritonealized. On the raw diaphragmatic surface, owing to its great depth and constant oozing of blood, no actual opening connecting with the lung could be detected, although this was the only possible site of such communication. The common bile-duct was now incised and twelve calculi were removed from it, after which a probe passed easily down into the duodenum and upwards into both hepatic ducts ; from the extremity of the left hepatic duct it passed for 1 in. through adhesions between the under surface of the liver and the stomach, and was then felt beneath the line of suture in the liver (whence the V-shaped segment had been excised), thus demonstrating the path of communication between the left hepatic duct and the interior of the excised calcified swelling. The gall-bladder, containing several small calculi, was then removed, a drainage tube sutured in the common duct, and the incision in this duct closed around it. Larger drainage tubes were placed in the right kidney pouch, and down to the raw area on the diaphragm, and the abdominal wall was closed in layers around them. Recovery was uneventful. The two larger drainage tubes were removed on the fifth day, that in the common duct on the tenth day, after which bile soon ceased to be discharged from the wound. There was a steadily-diminishing expectoration, of a frothy-white character and quite free from bile, for the first ten days. She left the Infirmary a month after operation, in good general condition, with the wound soundly healed, and quite free from any cough or expectoration.

The most probable sequence of events had thus been—gall-stones in the gall-bladder and common duct, suppurative cholangitis, perforation of the left hepatic duct, formation of a small subphrenic abscess between the extremity of the left lobe of the liver, diaphragm, spleen, and lesser curvature of the stomach, adhesion of the left lung to the upper surface of the corresponding area of the diaphragm, gradual inspissation of the contents of the abscess with thickening and calcification of its walls, extension of its lumen upwards through the diaphragm into the left lung, and finally rupture into one of the smaller bronchi, with development of a bronchobiliary fistula. That all these changes could have taken place without causing sufficient constitutional disturbance to have been noticed by, or to have impressed itself upon the memory of, an unusually intelligent patient, seems very remarkable. The final rupture evidently occurred on Dec. 2. The enormous thickening and calcification of the wall of the subphrenic abscess stamp it as of very long duration, and it was probably formed four and a half years before, when she had the only disturbance of health she can recall, and that but a slight one—headache and bilious vomiting—for which she stayed away from her office for a day an a half only, and even then was not confined to bed. The gall-stones must necessarily

have been of still longer duration, and were unassociated with any of the symptoms of 'flatulent dyspepsia' so frequently noted in cases of cholelithiasis.

The first collection of cases of bronchobiliary fistula was made by Courvoisier,[1] and consisted of 24 cases, 6 of which were seen only during life and recovered, and 18 seen at autopsy; of the latter, 10 were due to cholelithiasis, 6 to echinococcus cysts, and 2 to ascarides. In 1897 Graham[2] collected 11 further cases, including 2 of his own—1 due to gall-stones, and 1 caused by a kick from a horse, with rupture of the diaphragm; of the other 9 cases, 2 were due to an echinococcus cyst and 7 to cholelithiasis. Isolated cases continued to be published, and in 1912 Ido and Yasuda[3] collected 49, including one of their own, which during life had been considered to be due to syphilis of the liver, but at autopsy the changes were considered to be the effects of gall-stones, although none were then actually present. A search of the literature has yielded me only two cases published since Ido and Yasudu's paper, which I epitomize :—

Roper's Case.[4]—Widow, age 56. In September, 1910, had typical attacks of biliary colic. February, 1912, had right-sided pleurisy. March 16, in the course of ordinary cough, began to expectorate bile, as much as 20 oz. in the twenty-four hours. The liver was palpable 2 in. below the ribs, and was hard. On April 9 laparotomy was performed, and an impacted gall-stone in the common duct was removed by incision of the duct with suture. The gall-bladder was opened and drained, and two calculi were removed from it. The patient recovered.

J. E. Stumpff's Case[5] (For the translation of this paper I am indebted to Dr. Murk Jansen, of Leyden).—Stumpff reports a female, age 50, mother of three healthy children, suffered from attacks of biliary colic from 1903 to 1907.

Operation, *Dec.* 19, 1907, showed perforation of the gall-bladder, with considerable infiltration along the common duct. Cholecystectomy was performed, with gauze drainage; wound discharged for two months, then healed.

June, 1912, she had diffuse bronchitis with blood-stained expectoration; spleen and liver were both enlarged and firm; albuminuria, 5 per cent.

Aug. 24, 1912, was knocked over by a bicycle; three days later had severe pain in the right side, and coughed up large quantities of thin yellow frothy mucus, and the stools became colourless. Afterwards days of expectoration of bile alternated with days free from such expectoration.

Sept. 16, right pleurisy with effusion developed, but the fluid was free from bile; eleven days later, expectoration of bile finally ceased.

Nov. 14, death occurred after two days of peritonitis. An autopsy showed diffuse peritonitis, apparently extending from a pyonephrosis; extensive adhesions of both right lung and right lobe of liver to the diaphragm. Careful dissection of these adhesions disclosed a small cavity, the size of a pea, at the posterior and upper surface of the liver in the midst of the adhesions; it contained bile-stained fluid and communicated with both a bronchus and the bile-ducts. The main bile-ducts were much dilated, and the lower end of the common duct was completely obliterated. A narrow fistula existed between the common duct and the duodenum just beyond the pylorus. In the common duct were several small calculi and some bile-sand, the calculi being just sufficiently large to produce intermittently complete blockage of the fistula.

Altogether then, including my own case, we have 52 recorded instances of bronchobiliary fistula. The etiology in 46 of these is definitely known, since they came either to operation or autopsy. Of the remaining 6 seen during life and recovering without operation, 1 was thought to be due to cholelithiasis, 1 to syphilis, 3 to suppurating hydatid cysts, and in 1 no cause was known. Of the 46 cases of known etiology, 29 were due to cholelithiasis (63·04 per cent), 10 to echinococcus cysts (21·7 per cent), 5 to abscess of the liver (1 'idiopathic', 2 due to amœbic dysentery, and 2 to ascarides in the bile-passages), and 2 to trauma—Graham's case of horse-kick, already mentioned, and Tyrman's[6] case of gunshot wound. Laceration of the diaphragm is an essential feature of the injury in these traumatic cases.

No case is reported of primary lung disease leading to a bronchobiliary fistula.

REFERENCES.

[1] *Beitr. über Pathol. u. Chir. Gallenwege*, 1890.
[2] *Trans. Assoc. of Amer. Phys.*, 1897, xii.
[3] *Beitr. z. path. Anat. u. allgem. Path.*, Jena, 1911, lii, 577.
[4] *Practitioner*, 1912, lxxxix.
[5] *Nederl. Tijdschrift v. Geneeskunde*, Amsterdam, 1913, i, 232.
[6] *Arch. f. klin. Chir.*, 1909, lxxxix, 434.

TRACTION FRACTURE OF THE LESSER TROCHANTER OF THE FEMUR.

By H. POSTON, Manchester.

Amongst the fractures which are caused by strong muscular contractions is the rare traction fracture of the lesser trochanter of the femur. An example of this injury has recently been observed at Ancoats Hospital, Manchester, and I am indebted to Mr. Platt for permission to publish the notes of the case.

W. A., a boy, age 14, was brought to hospital on Nov. 1, 1920, with the following history: Whilst playing football three days previously, in the act of kicking the ball with his right foot, he felt something crack in the right groin. He dropped down and was carried from the playing field. From the moment of injury he was unable to walk. When seen in the out-patient department he complained of severe pain, referred to the right inguinal region when he assumed the upright position, and aggravated when he attempted to bear the body weight on the injured limb.

On examination of the joint no obvious external abnormality was detected. There was some slight tenderness on palpation in Scarpa's triangle; passive movements at the joint were all free. Whilst patient was placed in a sitting position with the thigh at right angles to the trunk, he was unable to flex the thigh from the right-angled position. This phenomenon—Ludloff's sign—aroused suspicion of avulsion of the lesser trochanter of the femur, and a diagnosis of this condition was made. An *x*-ray examination (*Fig.* 238) showed, in the region of the lesser trochanter, a detached piece of bone drawn upwards. The diagnosis was thus confirmed.

The injured limb was encased in a plaster spica with the thigh flexed at the hip to 75°. After fourteen days, during which time patient was on crutches, the plaster was removed and the patient given massage and passive movements. Seen thirty-six days after injury he had full functional recovery and was walking without limp or pain. An *x*-ray examination at this stage showed the detached piece of bone close to the old bed of the lesser trochanter. *Fig.* 239, an *x*-ray plate taken in May, 1921, shows the firm union between the trochanter and the femur.

Ruhl,[1] of the Frankfort University Surgical Clinic, has recently made an exhaustive search of the literature of these cases, and, including one reported by himself, quotes a series of 22 cases of fracture or epiphyseal separation of the lesser trochanter. Usland,[2] writing on traction fractures, quotes a case coming under his observation of traction-fracture of the lesser trochanter. The case under review brings the total to 24.

Etiology.—The age incidence of the 24 cases is as follows:—

Under 10 years ..	.. 1 case	..	4·2 per cent
From 10 to 20 years	.. 19 cases	..	79·2 ,,
From 50 to 70 years	.. 1 case	..	4·2 ,,
Over 70 years	.. 3 cases	..	12·5 ,,

It will be seen, therefore, that it is largely a lesion of the second decade, almost 80 per cent of the cases occurring in young people between the ages of 10 and 20—the injury resulting in epiphyseal separation of the lesser trochanter. Those occurring in elderly people are due to rarefaction of the trabecular structure of the lesser trochanter and consequent loss of resistance to violent psoas traction.

The constant factor, no matter what may be the circumstances of the injury, appears to be an abnormal traction exerted through the psoas muscle on the lesser trochanter when the femur is fixed. The mechanism is brought into action by the effort of the iliopsoas

to restore the equilibrium of the body when the latter is suddenly thrown forward or backward. This is illustrated by the case recorded by Ruhl. Here the patient was jerked backwards whilst in a train beginning to move off. He immediately braced himself by throwing the body weight on the left lower limb; at the same time he felt a sudden pain in the left groin, and was, owing to the extreme pain, absolutely unable to walk. Feinen, who has observed one of the cases collected by Ruhl, thinks the cause of the fracture is passive stretching of an already contracted iliopsoas muscle. He illustrates this theory by the case observed of a man who, falling suddenly forward, jerked the trunk into an upright position, as a consequence avulsing the lesser trochanter of the right femur.

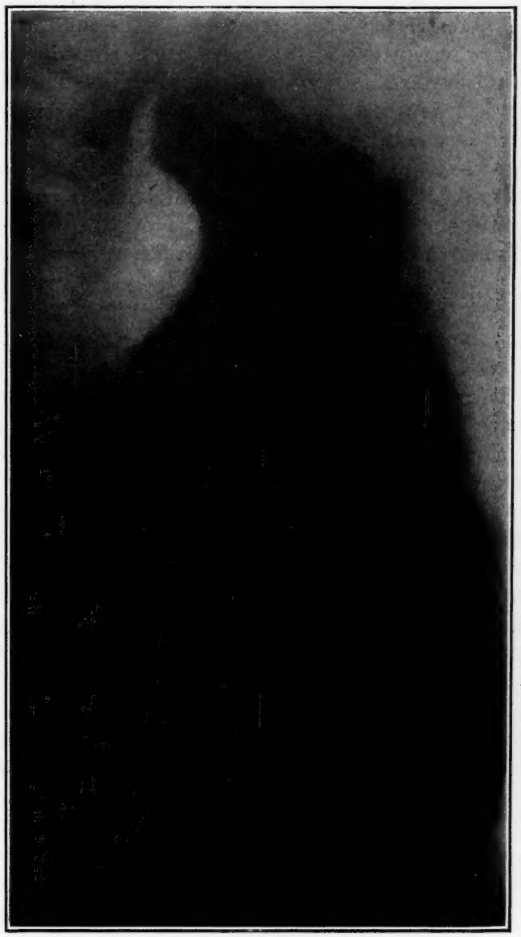


FIG. 238.—Skiagram on admission, showing detached lesser trochanter drawn upwards.

FIG. 239.—Showing the firm union between trochanter and femur.

Symptoms.—Pain and tenderness are constant features. In all the recorded cases the patients complained of acute pain referred to various points in Scarpa's triangle. The situation of the point of maximum tenderness is apparently variable, and it may be elicited in different areas in Scarpa's triangle. Ruhl in his essay is very dogmatic on this point. He says, "In my opinion the point most sensitive to pressure lies in the gluteal fold somewhat to the end of the inner third of the fold, between the adductor and flexor group of thigh muscles. If one moves from this point in the direction of the femur, the trochanter minor is encountered. This point should be examined in suspected cases".

Attention should be paid to this point in examining suspected cases, for it is the site of election for the exposure of the lesser trochanter of the femur in open operation.

Loss of function was a variable feature in the cases of Ruhl's series, various degrees of functional disability, from complete loss to moderate impairment of locomotion, being observed. Swelling is apparently not a constant sign. In 20 per cent of observed cases there was swelling and discoloration similar to that observed in fractures of more superficial bony structures. Jouillard attributes this swelling, very marked in his case, to injury of the medial or lateral, or both, circumflex branches of the profunda femoris. Injury to these vessels is possible, but would be attended with very marked hæmatoma production.

Passive movements, although painful, are unrestricted. Active movement of the injured limb, especially flexion at the hip-joint, is restricted or in abeyance. The inability of the patient to flex the limb at the hip-joint when in the sitting position is considered by Ludloff,[3] of Frankfort, to be diagnostic of psoas insufficiency, and the phenomenon is known as Ludloff's sign. The presence of the sign depends on the extent of the traction-fracture. In the case of incomplete trochanteric separation, where the trochanter retains a certain degree of periosteal attachment, or where the displacement is inhibited by the fibres of insertion of the iliacus muscles (which are often prolonged 1 in. downwards and in front of the lesser trochanter to be inserted into the body of the femur), a varying range of flexion is possible. The impairment of flexion is the only functional disability for which any anatomical basis exists.

Diagnosis.—Before the introduction of *x*-ray examination it is probable that many cases of this lesion were looked upon and treated as fractures of the neck of the femur. In each of three recorded cases there was a definite diagnosis of fracture of the neck of the femur. The grounds for this diagnosis were apparently: (1) The age of the patient; (2) The position of the limb in external rotation of the leg and eversion of the foot, as found in fracture of the neck of the femur. Against this, in each case where measurements are recorded, the clinical reports show that there was no shortening of the affected limb, and that no displacement of the great trochanter was observed. The external rotation may be partially explained by the loss of psoas control on the femur. Jouillard contends that the outward rotation of the limb is a reflex phenomenon, due to the inhibition of the muscles in the affected area by trauma and effusion of blood in their vicinity, the limb rolling outwards by its own weight.

The final appeal for aid in diagnosis is made to the *x* ray.

Prognosis.—In cases uncomplicated by other lesions, and in the young, prognosis is apparently uniformly good. In the aged, when this fracture occurs, there seems to be every reason to believe that, after the initial shock is countered, and suitable—preferably ambulatory—treatment is early established, the result should be equally satisfactory. In the recorded cases the treatment was varied; but in spite of the variations the patients all attained good functional results. Five cases of the series were treated by extension and massage, Verschutz giving as the reason for the extension that this position permits the absorption of the effused blood.

It is obvious that, owing to the contraction of the psoas muscle, the only treatment which will secure accurate apposition and retention of the displaced trochanter is fixation by operation. This treatment, in view of the results obtained by less drastic methods, is undoubtedly heroic. The method of treatment adopted in my case is simple, yields a perfect functional result, and can be carried out with the patient under regular observation in a hospital out-patient department.

REFERENCES.

[1] RUHL, "Ueber isolierten Abriss der Trochanter minor," *Bruns' Beitr. z. klin. Chir.*, 1920, 118.
[2] USLAND, *Medinsk Rev.*, 1920, Oct.
[3] EBERSTADT (Ludloff's Clinic), *Münch. med. Woch.*, 1919, Sept. 5.

THE OPERATIVE TREATMENT OF CLOSED FRACTURES OF THE LONG BONES BY METAL BANDS, WITH A DESCRIPTION OF A NEW INSTRUMENT.

By E. GERALD STANLEY and JEAN GATELLIER, Paris.

INTRODUCTION.

During recent years much thought has been given to the operative treatment of fractures. At first discussions centred round the mechanical aspect of such treatment, some preferring the osteosynthesis obtained by extraperiosteal means (Parham-Martin bands, wires, etc.); others the union maintained by screws, nails, hooks, etc., penetrating the bone itself. Very soon the problem became complicated by the perfection of sterilized bone-grafts, Albee in America and Nageotte in France leading the way, this work being stimulated by the researches of Leriche and Policard,[22] which seemed to discredit fixation by metal plates, whether fixed by screws or bands (as giving rise to the formation of necrosis and superficial sequestra). Later still, operative treatment was shown to be a factor in delaying consolidation, the traumatism of the intervention itself being the cause. In the present article we present the results of research into the immediate and remote effects obtained by the use of Parham's bands, applied alone in cases of oblique fractures, but associated with plates of metal or bone in transverse fractures.

We desire to express our indebtedness to M. Pierre Duval, Professor at the Faculty of Medicine of Paris, for facilities of research and clinical work, and also for access to the records of his clinic which he most kindly put at our disposition.

We first directed our attention to the advantages of, and indications for, the use of Parham's bands, and in this connection especially to the action of metal plates on new bone formation. The general indications for the use of Parham's bands in fractures of the long bones have recently been set forth at length by various authors, and may be generally accepted. The technique has been well described recently by Digeon,[18] especially as regards muscular interposition, methods of reduction, and the protection of nerves in relation to the fracture. We wish especially to claim for Parham's bands several very definite advantages, once the general principles of osteosynthesis by open operation are realized.

1. *The Ease of Application and the Simplification of Material used.*—The introduction of Parham's bands is extremely simple; the area of application having been chosen, one merely has to pass the hollow curved director described later. The armamentarium of electrically-driven saws, screw-drivers, drills, etc., finds no place here. But above all, as the reduction takes place little by little under direct visual control, one is able to obtain a perfect linear coaptation, and at this moment, and not till then, maintain this union by tightening the band. On the other hand, when using plates and screws, it will be admitted that the slightest error in drilling the holes leads to an imperfect coaptation, and to redrill the holes seriously compromises the solidarity of the fragments. Therefore, in cases of *simple oblique* fracture we believe that the metal band is superior to the plate.

The coaptation with plate and screw may be perfect; with bands it always is. Two points must be noted: from the experience of our cases we believe it is a mistake to employ a single band; two at least must be used, each placed close to the extremity of a fragment (*Fig.* 240). This is an application of the law of levers; placed at the centre of the fracture (*Fig.* 241) the strength is greatly diminished. Nevertheless, one must be careful to leave at least 2 mm. between the band and the extremity of the fragment; otherwise the latter may disengage itself from the band, as in two of our cases.

In *comminuted* fractures bands are excellent: the band acts as a ferrule, drawing the fragments together, preserving smaller splinters, and forming a veritable 'conglomeration' of bone. Screws and hooks are useless in such cases; an alternative is the employment of several or branched plates, but these are objectionable by their multiplicity, and often split the smaller fragments, already numerous enough, and thus prejudice their vitality.

Lastly, Parham's bands are equally indicated in *transverse* fractures, if associated with metal or bone plates. We discuss later the merits of these plates.

2. *Superiority of Parham's Bands to Other Methods of Circular Ligature.*—These bands are flat, and do not cut or damage the periosteum, as is the case where wire is used; the compression is gradual and controlled at will. Wire certainly damages the periosteum severely, and we have seen cases where the bone itself has suffered from the force necessary to retain the fragments. Furthermore, in twisting the ends of the wires, one frequently breaks them, or the twisted ends break off flush in hammering them snugly to the bone. The twisted end may irritate the tissues and cause a fistula in the absence of sepsis. Cunéo has introduced a 'safety knot': this does not break or twist off, but the end may cause irritation. In any case the reduction and its maintenance by wire is more or less guess-work, as compared with the easy compression and traction given by Parham's bands.

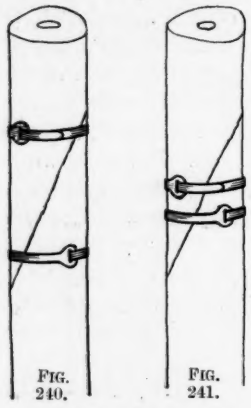


FIG. 240. FIG. 241.

FIG. 240. — Bands placed correctly near extremities of fragments.

FIG. 241.—Bands placed incorrectly near middle of fracture.

3. *Early Passive Movement.*—Early passive movement is the rule in all fracture treatment. Do Parham's bands give any advantage in this respect? Martin, of Philadelphia,[6] quotes the case of a patient, operated upon for fracture of the tibia by two Parham's bands, who became delirious on the night of the operation, left his bed, and walked: no displacement of the fracture occurred. Now there is no doubt that the mere traumatism of an operation does slightly delay union, especially early callus formation; therefore it must be always kept in mind that the maintenance of apposition is solely secured by whatever mechanical means have been employed, and this for rather longer than in non-operated fractures. Later the consolidation and union is stronger than in fractures treated by external splints. Now the question of mobilization, we believe, turns upon the length of the lever in question and the force that can be exerted on this lever. Thus:—

a. In fractures of the *forearm* we allow gentle mobilization at once (second day), the arm in the meantime resting in a plaster 'gutter splint'.

b. Fractures of the *tibia and the fibula* we mobilize on the fifteenth day, and allow walking with crutches on the twenty-fifth.

c. Fractures of the *humerus* must be treated with caution, for the humeral lever supports the weight of the arm and the leverage is powerful. Here mobilization is allowed on the tenth day and active movements on the twentieth, the arm in the meantime being merely slung and bandaged lightly to the thorax.

d. Fractures of the *femur* require much care and judgement. Digeon[18] mobilizes these cases as early as the thirtieth day: we cannot agree with him. Nearly all our accidents have occurred in these cases—bending of the callus, delayed union, etc.—and our practice is to keep these cases immobilized for at least fifty days.

How should these fractures be immobilized? In order to avoid large plasters we began by using continuous extension—bending and angulation occurred. We then tried the large plaster generally used for tuberculous diseases of the hip—exactly the same results took place while moulding the plaster after operation. We believe that the following method gives the best results: A bivalve plaster-cast is prepared beforehand and applied to the limb, which is maintained in continuous extension. The operation is performed with the thigh resting in the posterior valve; when completed the anterior valve is placed in position and the whole cast held together by bandaging.

4. *What are the Effects of Parham's Bands on New Bone Formation*?—We will now give a brief résumé of the disadvantages of metallic osteosynthesis; later we present the results of a study of cases upon which re-operation was necessary for various reasons, and of the study of a series of radiographs taken at various intervals from the time of operation to several months later.

Leriche and Policard[21] made recently a careful study of 15 cases of osteosynthesis by means of Lambotte's plates; but the fact must be noted that in all these cases the plate was placed *beneath the periosteum*. According to these authors, microscopic examination shows a certain amount of fibrous tissue external to the plate. Around the plate there is sometimes a sheath of new bone, while beneath it the bone immediately subjacent is dry, white, and avascular. If the plate was removed early (20 to 90 days) they found an extremely thin lamelliform sequestrum. Further investigation showed an ischæmic necrosis, and, deeper, the bone in the process of rarefaction. The central callus was slow to appear, and poor at that, and the tissues were impregnated with iron salts. Millet[22] repeated the researches of these investigators and confirmed their findings; he attributes this superficial necrosis to ischæmia, produced by compression and the destructive action of the body fluids attacking the metal. This writer states further that the plate is rarely covered by new bone. Albee[11] says that metal plates have no place in osteosynthesis. In the presence of these changes one easily understands that consolidation is delayed if metal plates are used.

Hallopeau,[19] Dujarier,[20] Frédet et Ronvillois[16] vigorously attacked these observations, from the clinical point of view, bringing forward their statistics and results. Hallopeau quotes an interesting case of a double symmetrical fracture in the same patient: one fracture was treated by Parham's bands, the other by external splints. Clinically the former consolidated very much more rapidly.

Cunéo and Rolland[23] examined the action of metal in the tissues, and the tolerance of the latter to the former. They found that the organic iron salts formed had no deleterious action on the tissues, bony or otherwise.

With this preliminary, we now proceed to give our own results, as shown by clinical investigation, radiographs, and the microscope, in cases where we have used (1) *Parham's bands alone*, or (2) *Parham's bands associated with plates*.

1. **The Employment of Parham's Bands Alone.**—An examination of radiographs taken in series shows, as early as the fifteenth day, irregular shadows, more or less opaque, completely surrounding the operative area and band. These shadows become increasingly distinct, till, by the twenty-fifth day, they extend longitudinally along the bone, the appearance being that of a spindle or tapering sheath.

In certain cases—especially in the tibia, clavicle, and bones of the forearm—the shadow remains more localized and does not extend along the bone. In other cases—the humerus, and especially the femur—the callus is excessive; but if radiographs, taken at the expiration of several months, are examined, one nearly always sees a distinct thinning of this callus, while in many cases it is reduced to a minimum.

Further, these radiographs show that the callus surrounds and covers the band, contrary to the assertions of the opponents of metallic plating; but we would call special attention to the small clear area, well seen in *Fig.* 262, between the callus and the band. This demonstrates that, in immediate contact with the band, early ossification is delayed; but radiographs show that later this clear space disappears. On the other hand, Frédet has seen this space persisting at eight months.

Radiographs taken in profile and anteroposteriorly after the callus has thinned out and 'settled down' reveal at once an irregularity in its development: it is always far better developed and more abundant on the side of the bone opposed to the track of operative approach. Hallopeau[19] has confirmed this, and believes that the mere exposure of a fracture by operation delays union.

In two of our cases (femurs) we were obliged to re-operate for pain. In both these cases essentially the same conditions were discovered, a bony mass completely hiding

the bands. After chiselling away this callus, the bands were found completely embedded and firmly fixed. The bands, which were of soft steel, were covered with a black, slightly-adherent layer, but no trace of rust was found, and no sequestrum. The tissue was extremely vascular, and the steady oozing could only be controlled by irrigation with hot saline solution. The new bone was more developed on the side of the fracture opposed to the wound, and was moderate in amount.

All authors have insisted that callus is more abundant in fractures treated by metallic osteosynthesis than by simple reduction. From this point of view it seems to us that Parham's bands give better results than other metallic appliances; but here we must again emphasize the fact that when using plates (Lane's or Lambotte's) and other methods of fixation (nails, screws, or hooks) the periosteum is always incised and the metal placed beneath it.

We believe that the interference with the periosteum, however carefully carried out, explains this trouble with callus formation. Now Parham's bands are always placed extraperiosteally. To the objection that the sensitive and vascular periosteum is traumatized and strangled, we reply that it is of little importance. We have only twice seen cases of persistent pain necessitating the removal of the bands, and as for strangling the periosteum it can matter little, for the blood-supply of this membrane is not longitudinal and continuous, but of the type of intestinal vascularization, by means of abundant and fine anastomoses. Furthermore, the bands in no way interfere with the periosteum at the line of fracture: it is here intact; while finally, all research, from Macewen to Gallie and Robertson,[24] shows that the periosteum is a vascularizing membrane primarily, and takes no part in actual bone formation apart from this property, important though it be.

Summing up: our study of cases treated by Parham's bands alone shows:—

a. A delay in consolidation hardly appreciable even if it exists.

b. Complete absence of necrosis at the point of contact of the bands.

c. A callus formation which is regular, reduced to a minimum, and completely surrounding the bands.

d. An absence of pain, and perfect toleration of the bands by the tissues.

e. Absence of rust or toxic action by organic iron salts.

2. The Employment of Parham's Bands associated with Bone or Metal Plates in Transverse Fractures.—Parham's bands find an application in transverse fractures if associated with metal or bone splints. At the beginning we used the metal plates to hand, namely, those of Lane or Lambotte; later, to obviate the bands slipping from the plate, we used Sherman's plates provided with grooves to receive the bands. Later still, bone-grafts (living and dead) having come to the fore, we used Parham's bands to fix various forms of bony splints. We wish first to submit certain points which we have found essential in the general technique of osteosynthesis, and then to describe the methods and material which have given us the best results.

FIG. 242.—Diagram showing points (A, B) at the edge of the plate where the band is liable to snap.

a. METAL PLATES AND PARHAM'S BANDS.—We have no hesitation in saying that Sherman's plates are far superior to all others in this combination. Extremely strong, they nevertheless present a very limited area of contact with the bone—a great advantage—at the same time being provided with grooves which render slipping of the bands impossible if the technique is correct. Lambotte's plates have been made with grooves, but being much thinner they necessitate a larger area of bone contact to give the necessary strength, which is unfavourable to the vitality of the underlying bone. We have already shown the advantages and disadvantages of metal plates, which are still under discussion; but upon one result of the use of such plates everyone agrees—the volume of the callus formed. Now in the femur, the tibia, and the humerus this excess of callus is of little or no importance, but it is otherwise when the clavicle or bones of the forearm are in

question. In these bones the exuberant callus is so disadvantageous, and may cause so much trouble, that we believe Parham's bands with plates to be contra-indicated if the fracture is distinctly transverse, and employ for preference either Dujarier's hooks, or drilling and wire.

What are the results of bands and plates? We have had several failures, bending of the callus occurring on mobilization. Can these accidents be explained or remedied? First, the tissues encircled by the bands are not homogeneous: the resistance offered by the bone and the steel plate is not the same, and there is no doubt that during the few days following operation the encircling force slightly diminishes, whether it be that the plate sinks into the periosteum, or that the band slips more easily on steel than on bone. We have certainly seen cases where the plate has slipped on the band. Another observation is that with mobilization the band may break, and we believe the reason to be as follows. The band after encircling the bone passes on to the plate (Sherman's), which is quadrangular, and in so doing bridges a very small triangular space between the former and the latter; it snaps at the edges of the plate (*Fig.* 242, A, B). This might be avoided by altering the form of the plate. We observed as an illustration of this the case of a young girl who was moved from hospital to her home because of a scarlet-fever epidemic. During transport both bands broke and the callus bent. Continuous extension produced perfect alinement, and on the seventieth day the plates and bands were removed from a mass of new bone which *completely surrounded them*.

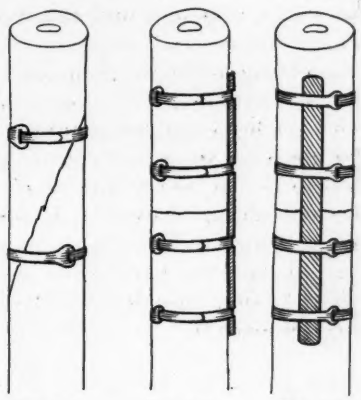


FIG. 243. FIG. 244. FIG. 245.

FIG. 243.—Oblique fracture, requiring two bands only.
FIGS. 244, 245.—Transverse fracture, requiring four bands.

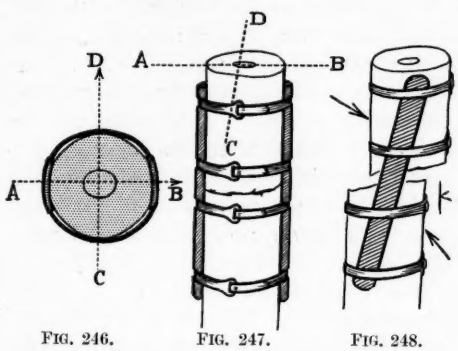


FIG. 246. FIG. 247. FIG. 248.

FIGS. 246, 247, 248.—Diagrams illustrating incorrect position of plates at opposite poles of the same axis (A B). The axis at right angles (C D) is unprotected, and displacement is liable to occur.

There is a great difference in the mechanical distribution of the force which may be applied to *oblique* or to *transverse* fractures. In oblique fractures the force is distributed in the length of the bone and in the direction of the weight applied, while in transverse fractures the maximum and optimum resistance of a plate is to force applied perpendicularly to it, a parallel force tending to cause displacement. We therefore use *long* plates fixed by *four* bands: two close to the line of fracture, two towards the extremity of the plate (*Figs.* 243, 244, 245). In fractures of the femur, where the fixation appliance has to withstand considerable strain, it is wise to use *two* plates. These plates should never be placed at the two extremities of the same axis (*Figs.* 246, 247, A B), because an axis with feeble resistance (*Figs.* 246, 247, C D) will be left unguarded. They should, on the contrary, be placed each at the extremity of two axes perpendicular the one to the other (*Figs.* 249, 250, A,C).

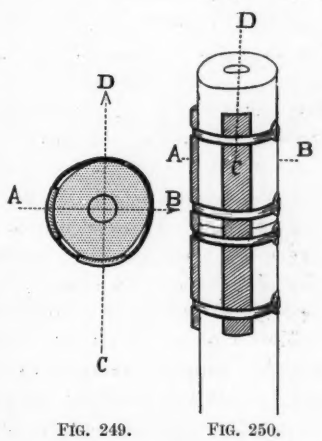


FIG. 249. FIG. 250.

FIGS. 249, 250.—Diagrams illustrating correct position of plates at the extremities of two axes (A B, C D) at right angles to each other.

b. BONE SPLINTS AND PARHAM'S BANDS.—Stimulated by the remarkable work of Nageotte and Sencert on the revitalization of tissues sterilized in alcohol, a large number

of surgeons attempted the use of sterilized bone transplants in human surgery. Although these bony transplants were totally different from the tissues used by these authors, both in their clinical behaviour and histological character, it was nevertheless hoped they would be vitalized and organized by the invasion of osteoblasts from the adjacent bone-ends. Gallie and Robertson[24] have recently shown by careful experiment that boiled bone may be thus invaded, vascularized, and absorbed, while at the same time new bone is formed.

We have had some experience in the use of bone transplants as splints with Parham's bands, and we now present our results and conclusions. By the courtesy of Professor Pierre Duval we are also able to bring forward the results of several of his cases, observed by ourselves. Duval used bone plates sterilized in alcohol in the form of a shuttle, resembling a Lambotte plate, provided with grooves for the bands: this plate was always placed *upon* the periosteum (*Fig.* 251). Hallopeau[19] uses a sterilized beef-bone plate some 10 to 12 cm. long, triangular on section, but with a rounded back, this plate also carrying four grooves for the bands (*Fig.* 252). Heitz-Boyer prefers a sterilized bone plate or splint resembling that of Hallopeau, but bearing lateral ridges which are destined to rest on the edges of the groove cut in the bone (*Fig.* 253). In the cases of the two latter plates a groove has to be cut to receive them into the bone at the site of fracture by means of an Albee saw.

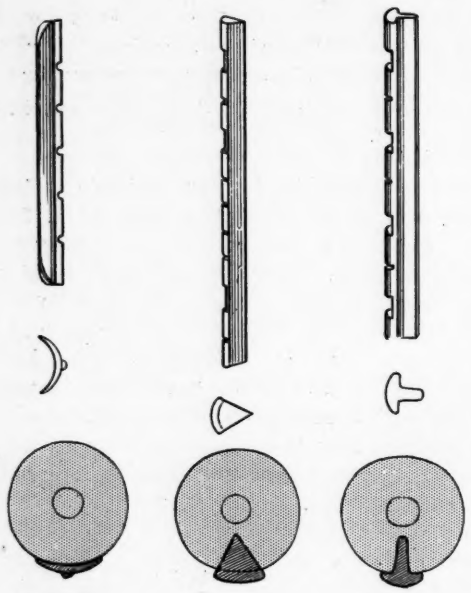


FIG. 251.—Duval's bone plate.

FIG. 252.—Hallopeau's bone plate.

FIG. 253.—Heitz-Boyer's bone plate.

Of Duval's cases, 9 consolidated and were satisfactory; in 2 a fracture of the plate occurred; and in 1 case severe infection took place; the wound was re-opened and the plate removed. The latter lay loosely on the bone and was soiled with pus. In each case where the bone plate broke, re-operation was necessary and the plate was removed. In no case was the plate incorporated with the living bone. No vascularization was seen; on the contrary, the bone appeared rarefied in contact with the plate, which was roughened but not surrounded by callus; the callus was well developed on the opposite side of the bone. In short, the plate was free and independent, both superficially and deep. The plates after their removal were examined by the kindness of Dr. Rolland, who reports that "histological examination shows that no invasion of osteoblasts from the neighbouring bone has taken place: there is no trace of commencing absorption, nor is the graft vascularized". Thus the conditions found where bone plates have been used are essentially the same as described by the opponents of metallic osteosynthesis. As to the cases which consolidated well and in which a good result was obtained, we found the same fusiform callus formation as when metal plates were used, especially developed on the side of the bone opposed to the plate, and in about the same period of time.

Our results, then, with bone plates have not been encouraging; but in view of the work of Gallie and Robertson we wish to emphasize that the bone was heterogenous, devoid of periosteum, and dead. In Nageotte's work he insisted on the employment of *embryonic* connective tissue, which condition the bone of an ox does not satisfy.

Lastly, if one hopes for vascularization, absorption, and osteoblastic invasion of the graft, it should undoubtedly be placed beneath the periosteum, while a great advantage of Parham's bands is their extraperiosteal position. To satisfy both these conditions would injure and compress this membrane, seriously compromising the result.

We therefore conclude that bone plates give no advantages from the point of view of consolidation, they lack the necessary resistance and solidity, and are apt to break. The operation is much more complicated if one uses bone splints, which need a groove for their reception: they are not incorporated in the callus, and are not converted into living bone. For these reasons it seems to us that bone plates are not preferable to those of metal, attractive as they may be in theory.

Instruments Required for Parham's Bands.—Those used by Parham and Martin are a tractor, an aneurysm needle to which the band is attached by a ligature, and bands of soft steel. These, with the operative technique, are well described by Digeon.[18] They have many disadvantages. Firstly, the method of passing the aneurysm needle and drawing the attached band through after it is clumsy and difficult. Where the needle passes, the band may not be able to follow; it becomes caught in the tissues, loses its direction, and twists. Frequently the ligature between the needle and band breaks. Tanton,[17] in face of these difficulties, invented a 'needle' provided with a hook for the 'eye' of the band; but, although an improvement, his 'needle' does not pass easily. One of us (J. G.) devised a hollow aneurysm needle (*'rail passe lame'*), which seems to us to overcome the drawbacks of previous instruments (*Fig.* 254). It consists in a hollow curved director, at right angles to its handle, and made in two sizes. This director having encircled the bone at the selected point, one introduces the band at the extremity of this instrument, which thus forms a tunnel through which the band slides. The director is withdrawn, leaving the band in accurate position. The latter must now be tightened: here, again, the tractor used by Parham is not all that could be desired, the band frequently twisting and slipping, and necessitating manœuvres prejudicial to asepsis. Frédet[16] suggested a long band with a 'running knot' at the centre tightened by traction with pressure forceps, a useless and tiring process.

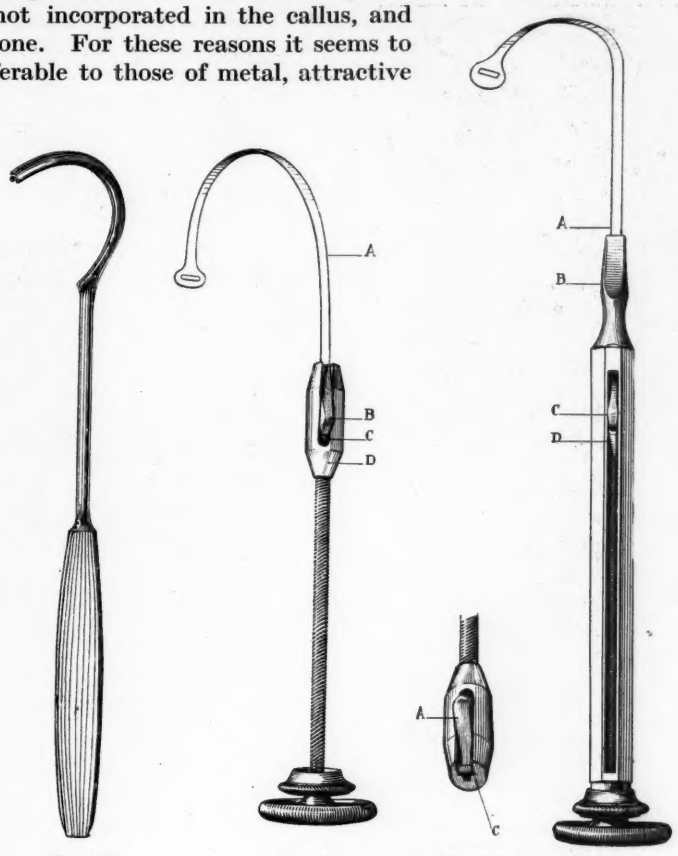


FIG. 254. FIG. 255. FIG. 256. FIG. 257.

FIGS. 254, 255, 256, 257.—Gatellier's instruments for use with metal bands.

Putti[3] has invented an excellent instrument, but we prefer that of Gatellier. The threaded stem of the tractor ends in the form of a shell 'nose-cap' (*Figs.* 255, 256, 257), which exactly fits into the hollow extremity of a cylinder containing this stem.

The latter at its extremity is provided with a slit the exact size of the band. The band, passing through this slit, meets an exactly similar slit in the 'nose-cap'; traversing the latter it now meets a cam which lifts the moment the slot of the band engages the former, a spring snapping back the cam into the slot. The band can now be tightened round the bone by a wheel acting on the stem, while the slot is disengaged from the cam by slight pressure on a button.

The apparatus takes to pieces readily for sterilization, and is re-assembled without screwing. It has given us every satisfaction, and is used in the service of Professor Duval.

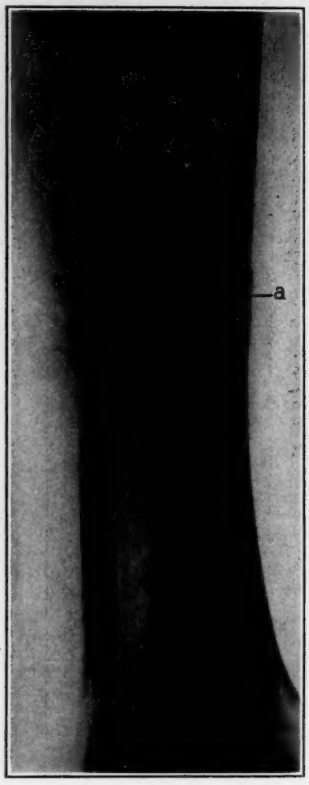


FIG. 258.—*Case* 1. Fracture of tibia and fibula, eight months after operation; perfect result. *a*. Slight constriction at band; callus insignificant.

FIG. 259. — *Case* 2. Supramalleolar fracture four days after operation.

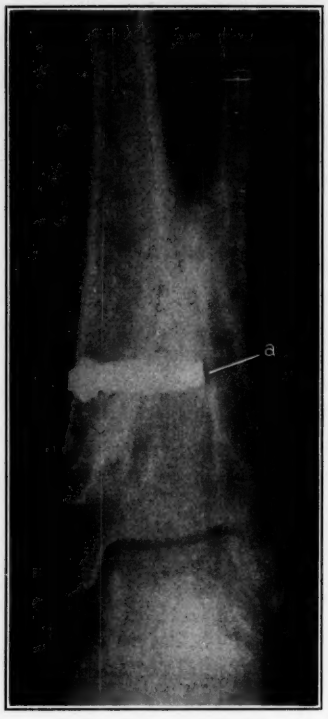


FIG. 260.—Same fracture as in *Fig.* 259, eleven months after operation; perfect anatomical result; very little callus. *a*, Slight constriction at band, which is not surrounded by callus.

ILLUSTRATIVE CASES.

Case 1.—(*Fig.* 258.) H. M., age 40. First seen July 2, 1920. *Operation*, July 5. *Discharged* Sept. 9. Oblique fracture of tibia, junction middle and lower thirds, fracture of fibula. Interposition of tibialis anticus. Reduction. Two Parham's bands. *Radiogram*, July 16, showed perfect position. Eight months after, *linear consolidation without appreciable callus.* Anatomical and functional result perfect.

Case 2.—(*Figs.* 259, 260.) L. S. First seen Jan. 30, 1920, for supramalleolar fracture with marked displacement of tibial fragment. *Operation*, Feb. 10, 1 Parham's band produced excellent reduction. Left April 1. *Radiogram* at 11 months shows perfect anatomical result. Minimum of callus; functional result excellent.

Case 3.—G. T. Supracondylar fracture of femur involving knee-joint. Considerable backward displacement of lower fragment.

Operation, Nov. 14, 1920. V-shaped incision, joint washed out, reduction, and 2 bands. *Radiogram*, 4 months later, showed circular callus enclosing bands, and not excessive.

Case 4.—M. M., age 32. Fracture lower third humerus. Posterior incision, 1 Parham's band, May 31, 1920. *Radiogram*, Dec. 4: Excellent reduction. Moderate amount of fusiform callus surrounding band.

Case 5.—G. H., age 60. Spiral fracture of tibia and fibula in lower third, with moderate displacement. *Operation*, Oct. 6, 1920. Reduction and 2 Parham's bands. *Rodiogram* three months later, showed good position; moderate fusiform callus formation; bands surrounded with small clear space at point of contact with callus.

Case 6.—(*Figs.* 261, 262.) P. C. Admitted Oct. 30, 1920, fracture of middle third of humerus, and of both bones of both forearms. Extreme displacement and comminuted fracture (3 pieces).

Operation, Nov. 14, 1920, after failure of non-operative treatment. Radial nerve freed, bone-ends trimmed, and 1 Parham's band placed encircling all three fragments.

FIG. 261.—*Case* 6. Fracture of humerus two days after operation.

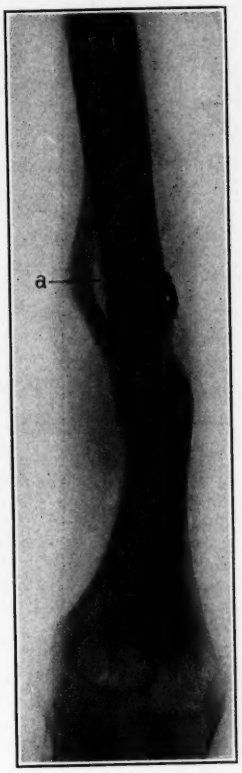


FIG. 262.—Same fracture as in *Fig.* 261, seven months after operation. *a*, Large clear space in contact with the band.

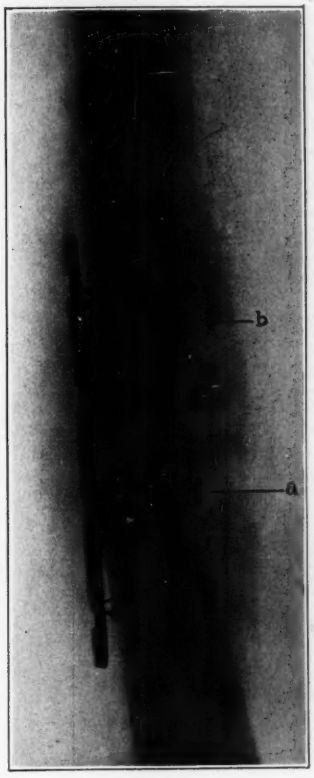


FIG. 263.—*Case* 7. Fracture of femur three months after operation; moderate amount of callus on side opposed to plate. *a*, Clear space. *b*, Callus opposite the plate.

Radiogram, Feb. 24, 1921, showed perfect reduction and position. Three months later, voluminous callus formation with clear space round band. Function good.

Case 7.—(*Fig.* 263.) D. J., age 15, seen Sept. 1, 1920, with fracture middle third of femur. Effusion into knee-joint aspirated several times. *Radiogram* showed transverse fracture with much displacement. *Operation* Sept. 10. Incision through vastus internus and reduction by Lambotte's tractor. Two Sherman's plates and 2 Parham's bands, with 2 wire loops.

Radiogram.— Perfect reduction. Four months later, moderate callus formation, especially developed on side of bone opposed to plates. Bands embedded in callus, with small clear space around.

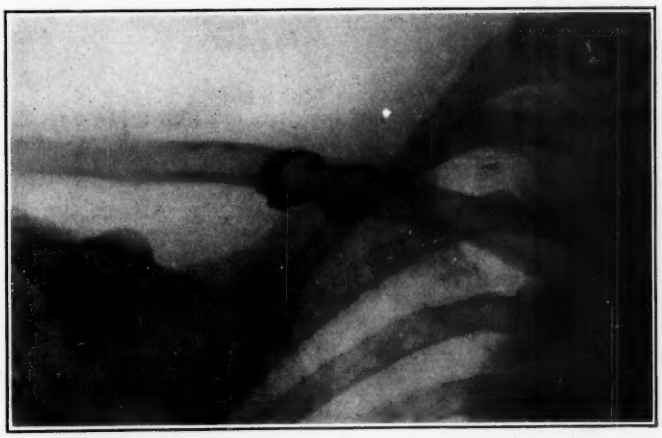


FIG. 264.—Fracture of clavicle after operation; perfect result.

Case 8.—(*Figs.* 265, 266.) G. S. Seen July 7, 1920. Transverse fracture of tibia and fibula at junction of middle and lower third.

Operation.—July 9. Reduction. Sterilized bone-plate and 2 Parham's bands.

Radiogram.—July 11. Excellent reduction and position. Walking on thirty-fifth day. Two and a half months later some pain.

Nov. 2. Bone-plate broken, callus formation on side of bone opposed to bone plate, band hidden by callus, and usual clear space round band.

Re-operation, Nov. 5. The two pieces of bone plate lay free, red appearance, and not invaded by new bone. *No* callus round plate, but entirely on other side of the bone, where it was excessive. Bands were covered by callus, but were easily cut and withdrawn. Small clear space around band.

Case 9.—(*Figs.* 268, 269.) V. A. Admitted to hospital Sept. 11, 1920, with a *transverse* fracture of upper third of thigh, marked overlapping and displacement. Put on continuous extension.

Not satisfied with reduction. *Operation*, Oct. 4, 1920. Bone-ends trimmed, 2 Sherman's plates and 4 Parham's bands placed. *Radiogram.* Reduction and position satisfactory. Ward was closed on account of a serious scarlet-fever epidemic. Patient returned Dec. 7 with bowing of the thigh.

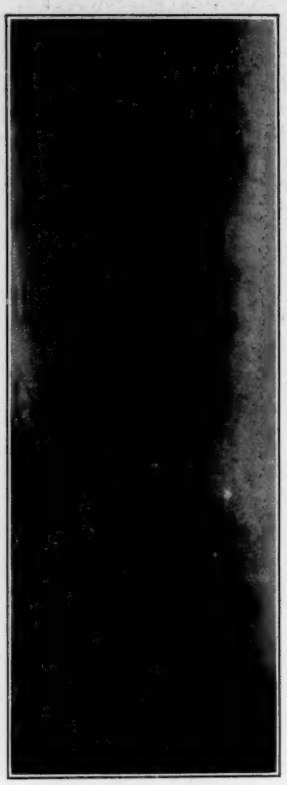


FIG. 265.—*Case* 8. Fracture of tibia and fibula forty days after operation; bone plate broken, callus minimum.

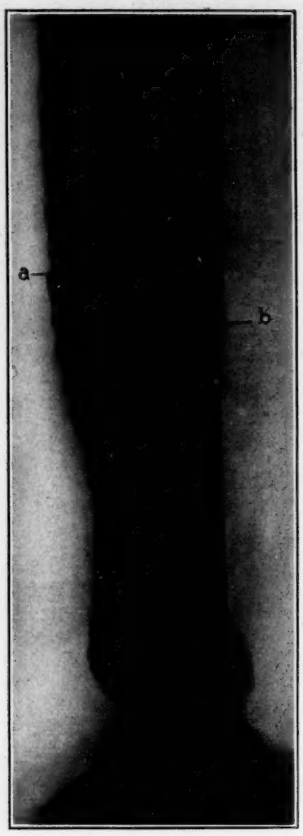


FIG. 266.—Same fracture as in *Fig.* 265, four months after operation; callus developed on side opposite plate; clear space well shown. *a*, Fracture of bone plate. *b*, Clear space.

Radiogram.—The bone is bent; the bands are intact, but one Sherman's plate has slipped from beneath a band allowing this bending. Dec. 11, continuous extension applied. Jan. 20, re-operation. Bands and plates removed. Latter not covered by callus, former well embedded. April 21, *Radiogram.* Sound consolidation; callus moderate in amount; result fairly good.

Case 10.—(*Fig.* 267.) L. L., age 23. Fracture lower third of thigh. Upper fragment displaced externally, and lower markedly backwards.

Operation, Sept. 20, 1920. Bone extremities trimmed and regularized. *Bone* plate fixed to external surface of femur by 4 Parham's bands. Plaster.

Radiogram next day. Very good position and reduction.

To note: Technique was bad. (1) Bone-plate much too short. (2) Bands too near centre of plate.

On the twenty-fifth day the plaster was removed for massage, the patient made a sudden muscular effort with the leg, and the bone bent.

Radiogram.—The bone-plate has broken owing to faulty position of bands and powerful leverage overcoming weak resistance of too short a plate. Continuous extension for thirty days produced good result.

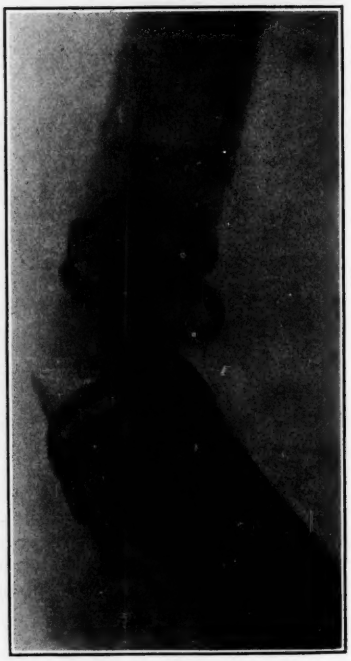


FIG. 267.—*Case* 10. Fracture of lower third of femur. This illustrates bad technique, the bone plate having broken owing to its being too short.

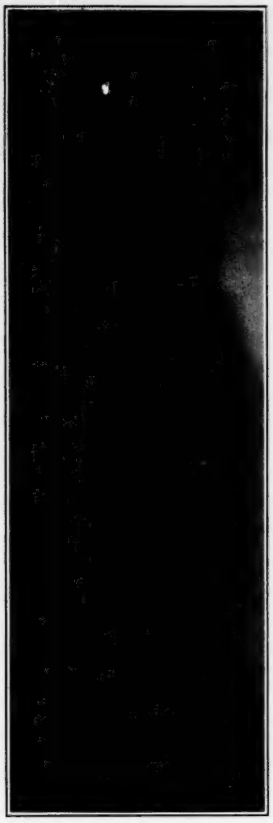


FIG. 268.— *Case* 9. Transverse fracture of upper third of femur in which a Sherman's plate has escaped from a band, allowing inflexion of the femur.

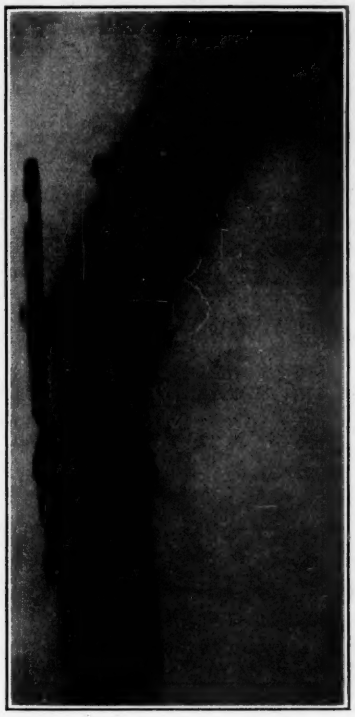


FIG. 269.—Same case as in *Fig.* 268.

FIG. 270.—*Case* 11. Transverse fracture of lower third of femur, showing another instance of faulty technique. Fixation is bad owing to the employment of two bands only instead of four. Sherman's plate, too, is better than Lambotte's. *a*, *b*, Clear spaces.

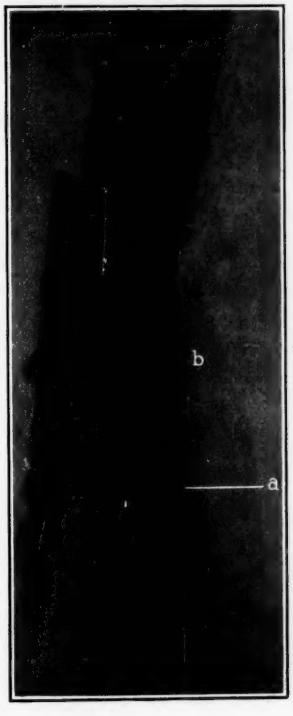


FIG. 271.—Another example of bad technique, showing callus developed on the side of the bone opposite the plate. Here again four bands should have been used, and Sherman's plate instead of Lambotte's. *a*, Clear space. *b*, Callus opposite the plate.

Case 11.—(*Fig.* 270.) D. F., age 52, seen in consultation April 4, 1920, with transverse fracture of the femur in lower third, with much overlapping of fragments.

Operation, April 10. External incision; the bone extremities were trimmed and 1 Lambotte's plate was fixed by 2 Parham's bands.

Radiogram.—Reduction and position good. April 22, slight bending noted.

Observe also the bad technique. Two fragments are displaced, the plate only offering resistance in a single axis: two plates should have been employed. Also four bands should have been used.

Continuous extension was applied, and resulted in consolidation in a good position by July 1.

SYNOPSIS OF THE ELEVEN CASES.

Cases 1 and 2.—Perfect anatomical result. Callus hardly appreciable, and linear union.

Cases 3, 4, and 5.—Very satisfactory anatomical result. Callus not exuberant, circular and fusiform. Bands embedded in callus, and a small clear area is visible around them.

Case 6.—Moderate callus surrounding band; well marked clear space.

Case 7.—Two Sherman's plates and four Parham's bands—certain amount of callus on opposite side to plates. Bands surrounded with clear space.

Cases 8 and 10.—Bone plates and Parham's bands. Bone plate broken and callus developed on opposite side to plate. Bands badly placed, and bone plate too short to resist.

Case 9.—Sherman's plates and Parham's bands. Bands loosened. Plate disengaged and slipped.

Case 11.—Lambotte's plate and two Parham's bands. Failure of resistance because only one plate was used (resistance in one axis only). Faulty fixation by two bands when four should have been used.

CONCLUSIONS.

1. The simplicity and the ease of application of the Parham-Martin bands establishes their superiority for closed fractures to all other means of operative splinting. Their application is carried out with the minimum of operative manipulation, and perfect apposition is ensured and maintained. They are better than wire for encircling the bone.

2. We have been able to observe the remote results of fractures thus treated in cases where we have been obliged to re-operate, and in a series of radiographs. They show that the objections made to metallic osteosynthesis, which are very real, cannot be applied to the use of Parham's bands. The consolidation is certainly not delayed, there is no necrosis at the point of contact of the band, and it is surrounded by callus (a small clear space may remain). Furthermore, any organic iron salts that may be formed have no toxic effect on the tissues; the callus is not excessive in quantity, and is frequently reduced to a minimum. Lastly, the bands very rarely give trouble from their presence, and may with confidence be left buried.

3. Transverse fractures require to be treated with metal or bone plates (or splints) encircled by the bands. Our results with bone plates have been very disappointing, though we admit Nageotte's principles in theory, and believe the work of Gallie and Robertson to be most valuable, though needing clinical confirmation in its application to recent fractures.

We are satisfied with our results with Sherman's metal plates and bands, but our failures corrected our technique. Certain principles in technique must be adhered to if perfect results are to be secured.

4. The improved instrument devised by Gatellier which we have described is a great improvement on all others, and is as near mechanical perfection as possible.

BIBLIOGRAPHY.

[1] PARHAM, F. W., "A New Device for the Treatment of Fractures," *New Orleans Med. and Surg. Jour.*, 1913–14, xxi, 451, 465.
[2] PARHAM and MARTIN, "Device for the Treatment of Fractures," *Mod. Hosp.*, St. Louis, 1916, vi, 75.
[3] PUTTI, "Un Novo Metodo di Osteosintesi", *Clin. chir. di Milano*, 1914, xxii, June 30, 1021.
[4] LUND, F. B., "The Parham and Martin Band in Oblique Fracture", *Surg. Gynecol. and Obst*, 1916, xxiii, 545.
[5] LUND, F. B., "The Parham and Martin Band in Oblique Fractures", *Trans. Amer. Surg. Assoc.*, Philadelphia, 1916, xxxiv, 422.
[6] MARTIN, *Fracture Clinic*, Philadelphia, 1917, 72.
[7] JONAS, A. F., "Indications for, and Results of, the use of Metal Bone Plates and Bone Grafts, and Conservative Methods in the Treatment of Fractures", *Nebraska Med. Jour.*, Norfolk, 1918, iii, 329.
[8] ENGLAND, F. R., "On the Modern Methods of the Treatment of Fractures", *Canad. Med. Assoc. Jour.*, Toronto, 1917, vii, 1072.

[9] DODGE, K., " Advantages and Disadvantages of the use of Metal and Bone Plates for Fractures ", *Wisconsin Med. Jour.*, Milwaukee, 1918, xvii, 10.
[10] DUVAL, PIERRE, *Pièces d'Os traiteés par l'Alcool pour les Interventions osseuses.*
[11] ALBEE, " The Fundamental Principles involved in the use of Bone-grafts in Surgery ", *Ann. of Surg.*, 1913, cxlix, 313.
[12] BARTLETT and HEWITT, " Experimental and Clinical Works to Determine the Value of Lane's Bone Plating," *Jour. Amer. Med. Assoc.*, 1912, ix, 51.
[13] BAILLIEUL, " Quinze Cas d'Ostéosynthèse métallique par Fil de Bronze, Plaque de Lambotte, et Cerclage de Parham ", *Réunion Médico-Chirurgical de la 20me Rêgion*, 1917, Nov. 10.
[14] DE BOUCHER, " Ostéosynthèse primitive précoce dans les Fractures par Projectiles de Guerre, principalement par la Méthode de Parham ", *Thèse de Paris*, 1918.
[15] COTTON, F. and DUFF, J., " Wire Banding for Fractures, with the Description of a New Instrument ", *Surg. Gynecol. and Obst.*, 1917, xxv, 557.
[16] FRÉDET, " Sur le Traitement des Fractures de Jambe par Ostéosynthèse ", *Bull. Soc. de Paris*, 1918, Nov. 13, 1763.
[17] TANTON, " Un nouveau Procédé d'Ostéosynthèse par Cerclage ", *Méd. de Paris*, 1918, 317.
[18] DIGEON, " Traitement des Fractures des Os longs par la Méthode de Parham et Martin ", *Thèse de Paris*, 1920.
[19] HALLOPEAU, " Des Lames métalliques dans le Traitement des Fractures ", *Bull. Soc. de Chir. de Paris*, 1920, June 13.
[20] DUJARIER, " Des Lames métalliques dans le Traitement des Fractures ", *Ibid.*, June 29, 990.
[21] LERICHE and POLICARD, " Recherches biologiques sur l'Ostéosynthèse et la Plaque de Lambotte ", *Ibid.*, July 2, 1145.
[22] MILLET, " Contributions histo-pathologiques à l'Étude des Prothèses osseuses ", *Thèse de Lyon*, 1919.
[23] ROLLAND, " Contribution à la Pratique de la Chirurgie osseuse ", *Thèse de Paris*, 1920.
[24] GALLIE and ROBERTSON, " The Repair of Bone ", *Brit. Jour. Surg.*, 1919, vii, 211.

VISITS TO SURGICAL CLINICS AT HOME AND ABROAD.

THE CLINIC OF DR. HUGH HAMPTON YOUNG:

THE BUCHANAN BRADY INSTITUTE OF THE JOHNS HOPKINS HOSPITAL, BALTIMORE, MARYLAND, U.S.A.

WHEN the Johns Hopkins Hospital was founded thirty years ago, an experiment in hospital organization and medical education was initiated, the success of which is freely recognized throughout the entire medical world. The graduates of that medical school are considered to have obtained the very best of medical educations, and the records of the Johns Hopkins *Bulletin* have been considered for long a treasure-house of careful, exact, and important scientific research. It is not to be wondered at, therefore, that the great majority of medical men visiting the continent of North America endeavour to include in their itinerary a visit to that famous institution.

In April, 1913, Sir William Osler was on a visit to the United States. The Peter Bent Brigham Hospital in Boston was then in the process of being built, and although not ready for a formal opening, the occasion was considered opportune for the baptism of the hospital which had been founded as the hospital of the medical school of Harvard University, created in the image of its parent, the Johns Hopkins Hospital, and imbued with the spirit of its progenitor, which Sir William Osler had been so largely responsible for creating. Speaking on that occasion, he described the nature of the new scheme of hospital management that was initiated when the Johns Hopkins Hospital was founded :—

> "At the Johns Hopkins Hospital we made a new departure in hospital management—that is, a new departure in this country—but by no means in medical education, for we simply adopted a combination of German and English methods. In the first place we were paid officials of the hospital. We followed the German system of organization in appointing a head of the service, with a group of house physicians, a group of subordinates, and with proper clinical laboratories. And we adopted the English plan of regarding the student as a part of the hospital organization—as large a part as an intern or nurse—of making him feel that he was not in the ward simply as a matter of granting him certain rights, but that he was there to get his education as a clinical clerk or surgical dresser. I have always felt that as soon as a student enters the hospital he should begin to get his information just as he gets it when he goes out into practice, by daily contact with patients in the out-patient department and wards."

This system of medical organization and its influence on medical education can be studied at its best in the Johns Hopkins Hospital where it was initiated. At the same time most visitors, like the author of this article, will be keen to observe how far the success that has attended it is due to the perfection of the organization, and how far it has been influenced and brought about by the unique combination of medical men who were gathered together on its original staff. Some would even be prepared to say that any hospital, however organized, that had on its staff such men as William Osler, Welch, Halsted, Kelly, and Councilman, was thereby certain of success.

In our visit to the Johns Hopkins Hospital, and especially the Buchanan Brady

Institute under the care of Dr. Hugh H. Young, we therefore studied it from two aspects, the first being the perfection of its organization, and the other the influence of the personality of those directing it.

If the medical visitor is keen on his profession he is sure of the most cordial and hearty welcome from its staff.

Osler once remarked that there were three signs by which fogyism can be recognized in an institution (or man). They are: "First, a stage of blissful happiness and contentment with things as they are; secondly, a supreme conviction that the condition of other people and other institutions is one of pitiable inferiority; and thirdly, a fear of change,

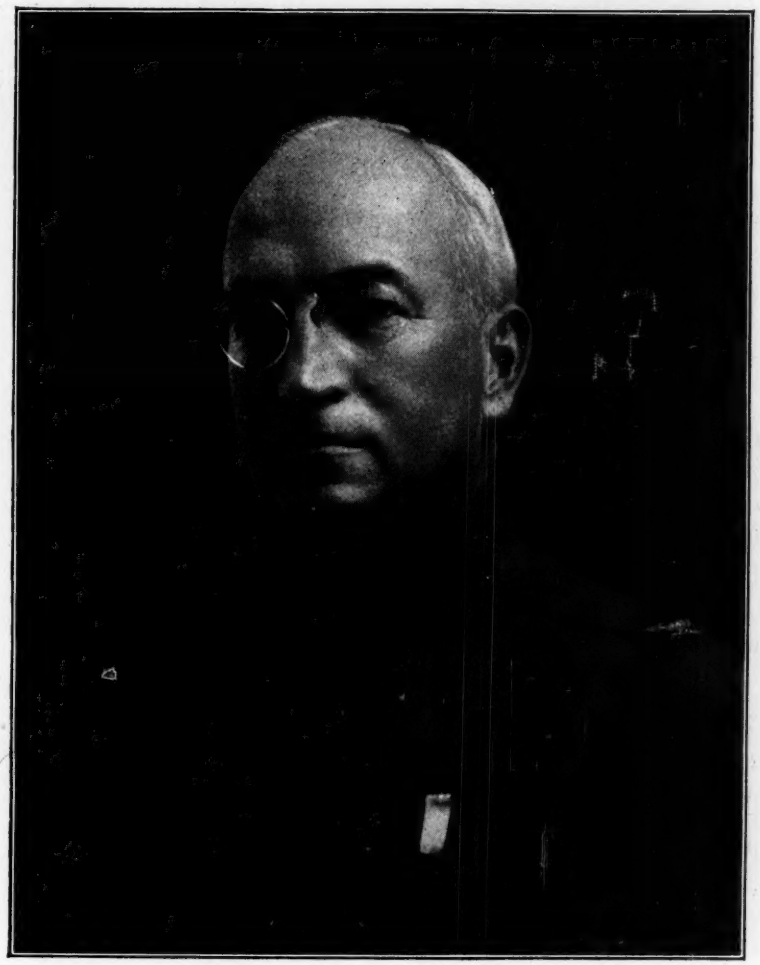


FIG. 272.—Dr. Hugh Hampton Young.

which 'not alone perplexes but appalls.'" The spirit of Osler is still evident, and although there is much in the hospital that would even justify what has been described as the calamity of self satisfaction, no evidence of this is apparent, and an insistent desire for progress in a forward direction is manifest at every turn.

Since the Johns Hopkins Hospital was originally founded, three special departments have been added—the Phipps Institute of Psychiatry, the Harriet Lane Department for Sick Children, and, lastly, the Buchanan Brady Institute of Urology, which was opened in 1914. This undoubtedly is the most complete Institute of Urology that exists in any

part of the world. It stands within the grounds of the hospital and is an eight-storied block connected with the Urological Out-Patient Dispensary of the Hospital.

Entrance to the Institute can be conveniently gained from the main corridor which connects the various wards of the hospital. In passing down the corridor, the visitor reaches the entrance hall, on the left wall of which a portrait of the founder, J. Buchanan Brady, is seen. The picture reveals the features of a typical Irish-American, a man of obvious ability, shrewd and genial. The junior students know him as 'Diamond' Jim Brady, a name he is said to have earned for himself owing to a characteristic that the artist has not failed to bring out, and that is his fondness for those precious stones. He

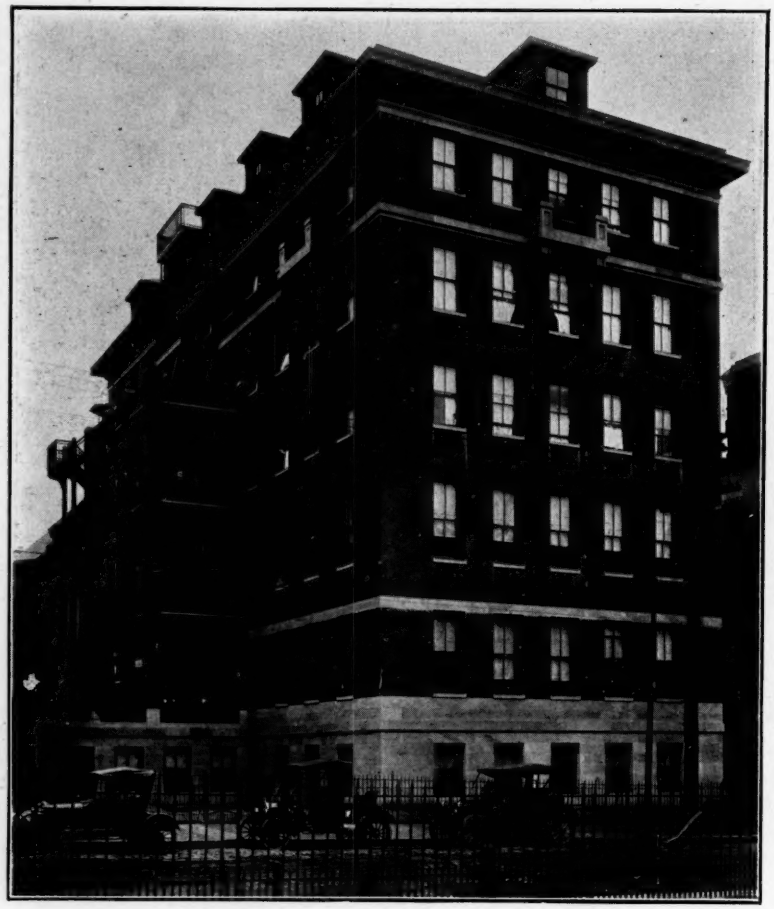


FIG. 273.—The Buchanan Brady Institute of the Johns Hopkins Hospital.

is said to have made his fortune in railway construction, and in the disposal of a part of it he has undoubtedly produced the most valuable jewel of all his collection.

The entrance hall leads to the second floor of the Institute ; but in order to understand clearly the plan of the building and the arrangements for its working, the visitor should proceed to the floor beneath, where the clinical examination department is situated, and from which the work of the Institute is, in the main, directed. On his right, as he descends the stair to this floor, is situated the waiting-room for out-patients, and to it patients from the wards above who require cystoscopic or other examinations can be brought by means of the elevator. The arrangements of this department are such that a long corridor extends down the centre, and on the left of it nine rooms are situated.

These are mainly arranged for cystoscopic examinations; but before entering them the visitor will be met in the corridor by Dr. Young's private secretary, and on presenting to him his credentials will be introduced to Dr. Young, if this be one of the days when he is not engaged in the operating theatre, or with clinical lectures.

Dr. Young is the director of a highly organized and complex mechanism equipped to execute urological diagnosis and treatment rapidly and accurately. It must be difficult to be welded into such a position and avoid becoming metallic in nature, but such we do not find him.

In the soft accent of the South you receive a cordial and hearty greeting, and at once you are made to feel at home in your new surroundings. The smoothly running machine moves on, and as you move with it you observe one of the secrets of Dr. Young's success, which is the cordial esteem in which he is held by all his staff, and by his devoted patients. He is never too busy to give a sympathetic hearing to the convalescent patient returning

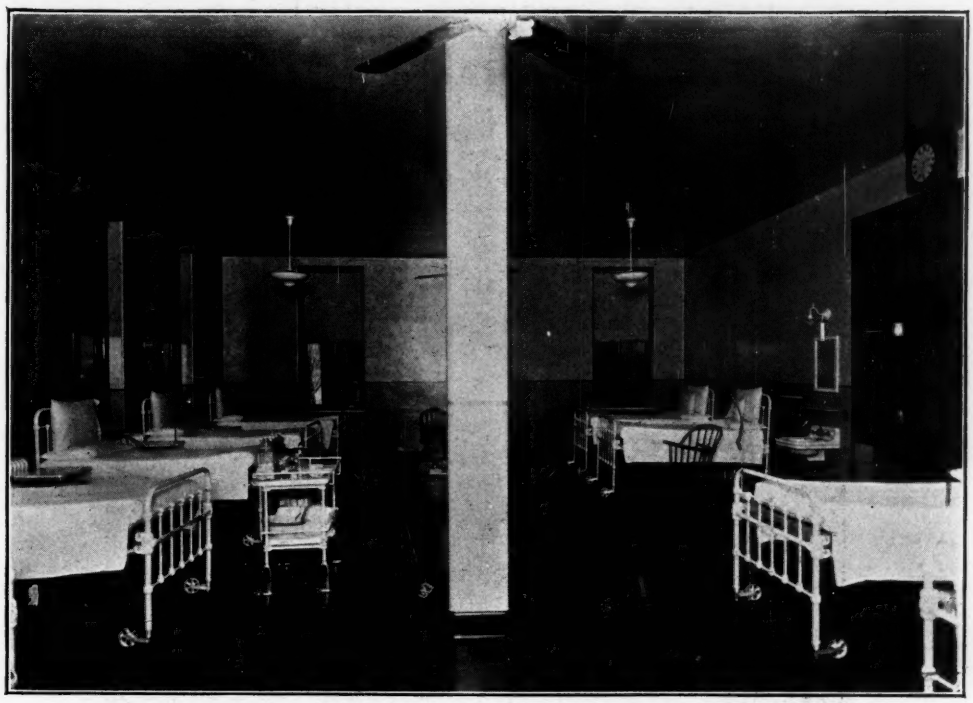


FIG. 274.—Small public ward.

home from his stay in hospital, or too occupied to recall old days with a medical colleague whom he last met when on service in France, or without time to settle the diagnostic difficulties of the most junior member of his staff. One of the latter put the case to me succinctly when speaking of his post-graduate training in various clinics: "Whereas", he said, "with my former chief the difficulty was to get any resident to stay with him, with Dr. Young, although he works you just as hard, the difficulty is to get any of his residents to leave him."

Dr. Young's staff in the Brady Institute consists of a resident and six interns, five associates and assistants in the private clinic, six associates and assistants in the out-patient department, and four assistants in the purely research department. Mr. Didusch is in charge of the department of medical art, and Dr. Waters and Miss Goldthwaite have charge of the radiography department. Laboratory technique is under the care of Mr. Elvers, and the clerical staff consists of his secretary, Mr. Slade, and five stenographers.

In addition to this, there are usually from three to five post-graduate physician students who remain from one to two years. The whole of this staff, including Dr. Young who is Director, devote the entire working day to service in the Institute. The arrangement with Dr. Young that permits of this is one that appears to be in every way ideal, satisfactory to the surgeon, to the great benefit of the Institute, profitable to the patient, and conducive to the advancement of science; for, gathered under one roof is a complete staff organized and equipped to carry out the investigation and treatment of the patients who are inmates of the public wards; and by a simple and satisfactory arrangement in the same building are situated the private consulting rooms and offices of the Director; and his private patients are accommodated in private wards within the public hospital. It thus means that the Director can organize his day's work in a manner that permits of a degree of efficiency in the Institute that could never be obtained if he were concerned only with visiting patients in the public wards for a limited period of the day.

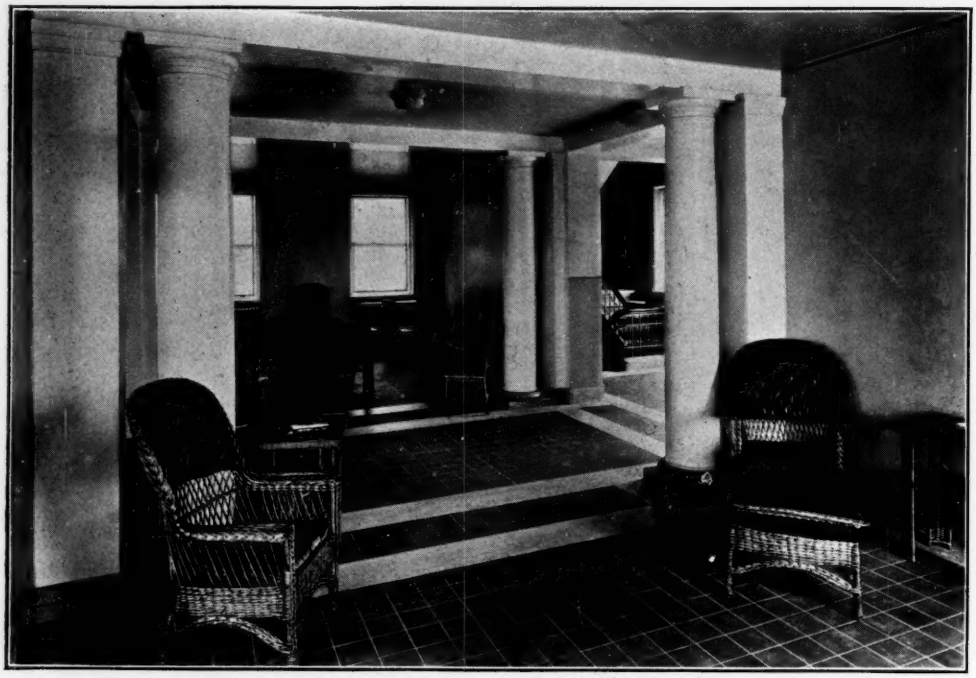


FIG. 275.—Recreation room for private patients.

As the writer observed it, the system worked out in practice in a manner that revealed the best ideals of a social democracy. Whether in the examination hall or in the operating theatre, the claims for priority in dealing with the patients were based entirely on the nature of the ailment from which they suffered and its urgency for treatment. The facilities of the Institute for the investigation and treatment of disease were equally at the disposal of all, and all appeared to receive equal care and attention.

The interns appointed to the staff of the Institute are all men who have had at least two years' experience of general surgery and are considered to be competent operators. The resident urologist usually remains two or three years before he becomes appointed, and after that for a further year or more. The last two resident urologists have been on Dr. Young's staff for five years. When it is remembered that prior to taking up the study of medicine he probably has had to obtain a degree in Arts, and that his student course has occupied six years, and thereafter two years have been spent in general surgery, and that several years are likely to elapse before he is appointed to the senior

charge as resident urologist, it will be understood how fifteen years may have been spent in preparatory training. On the other hand, it has to be remembered that the vast continent of America lies open to him who has reached such a position, and that when he leaves Dr. Young, in all likelihood it will be to occupy the post of Director of some similar Institute in one of the larger medical centres in America.

Before considering the organization of the Institute in detail, it will be of profit to visit the various departments and observe how they are housed.

If we begin with the clinical examination department on the first floor, where the out-patients and patients referred from the wards are examined, we find the small examination rooms on the left of the main corridor, as already mentioned. These are so arranged that in one of them a preliminary investigation of the patient's case is carried out by a junior member of the staff, and his case record dictated to a stenographer. He is then referred to one of the special examination rooms, where, the preliminary preparation having been carried out by one of the orderlies in attendance, Dr. Young or a member of his staff visits him and carries out the investigation required. As this is being conducted, the details of it are dictated to another stenographer in attendance, and if a special *x*-ray examination is found to be necessary, this can be rapidly executed, as the room is wired for this purpose, and the examination table—invented by Dr. Young—that is employed has the necessary *x*-ray equipment attached to it. The *x*-ray specialist is therefore requested to attend. The preliminary arrangements for taking the photographs occupy only a few minutes. The exposure is controlled from a lead-lined cabinet outside the examination room, but having a lead glass window looking into it, through which the operator can give the necessary directions without being personally exposed to the effects of the *x* rays.

The rooms to the right of the corridor are mainly allocated to chemical and bacteriological clinical investigations, and here are situated the dark room and viewing room of the *x*-ray department, with the *x*-ray library adjacent. Communicating with this floor of the Brady Institute, but in a separate building, is the out-patient clinic for the treatment of venereal disease. Work in this department is mainly conducted in the afternoon, and, like the former, it is equipped completely for its work. It is a separate department, complete in itself, with the great advantage of close proximity to the Brady Institute, to which occasional cases requiring special investigation can be referred.

At the time of our visit, Dr. Cecil was senior urological resident, and with him were associated Dr. Damming and Dr. Jack. Dr. Jack, who conducted us over the building, had been regimental medical officer to a battalion of the Devons in France, and with them had served for many months in the line in Flanders.

We first of all visited the research laboratories which are situated on the top story. Here we found a staff of whole-time chemists engaged in research. At the time of our visit they were investigating especially the antiseptic properties of certain aniline pigments, one of which gave promise of being specific for *Bacillus coli* infection. The red pigment known as mercurochrome, or 220, which is now being employed extensively through the medical world, originated in this department. Its advantages as a disinfectant, and its disadvantages as a permanent dye which left a lasting stain on linen or other articles, were observed. In the bacteriological laboratories there was demonstrated to us a new method of growing gonococci in oxygen of lowered tension.

We then visited the private quarters of the residents, which are situated on the floor beneath, and found them most palatial.

The private and public wards on the various stories were also inspected. The private wards consist of single rooms, certain of which have a private bathroom attached. Some of the public wards contain three beds, and a large and airy general ward is situated at the end of the corridor. Adjacent to the public wards are the doctors' side rooms in which the patients' charts and records are kept, these being made in duplicate, one copy being preserved in the department, the other being filed in the general hospital records. There also is in the vicinity a small ward sterilizing room, and it was here observed that the gum-elastic catheters used in the wards were sterilized by steam at 60 lb.

pressure for a quarter of an hour, the instruments being contained inside stoppered glass tubes. In the basement of the building are situated the animal houses used in connection with the department of experimental research. Here is also located the instrument makers' room, under the care of Mr. Hughes. At the time of our visit he was engaged in making several of Dr. Young's boomerang needles and the new pattern of cystoscopic rongeur.

Usually two forenoons of each week are given over by Dr. Young to operating. This is carried out in one of the theatres of the centrally-situated operating department of Johns Hopkins Hospital. By means of this excellent arrangement the special department of urology is kept in intimate touch with the general surgical service, thus conferring advantages on the latter, and itself receiving the many benefits of intimate association.

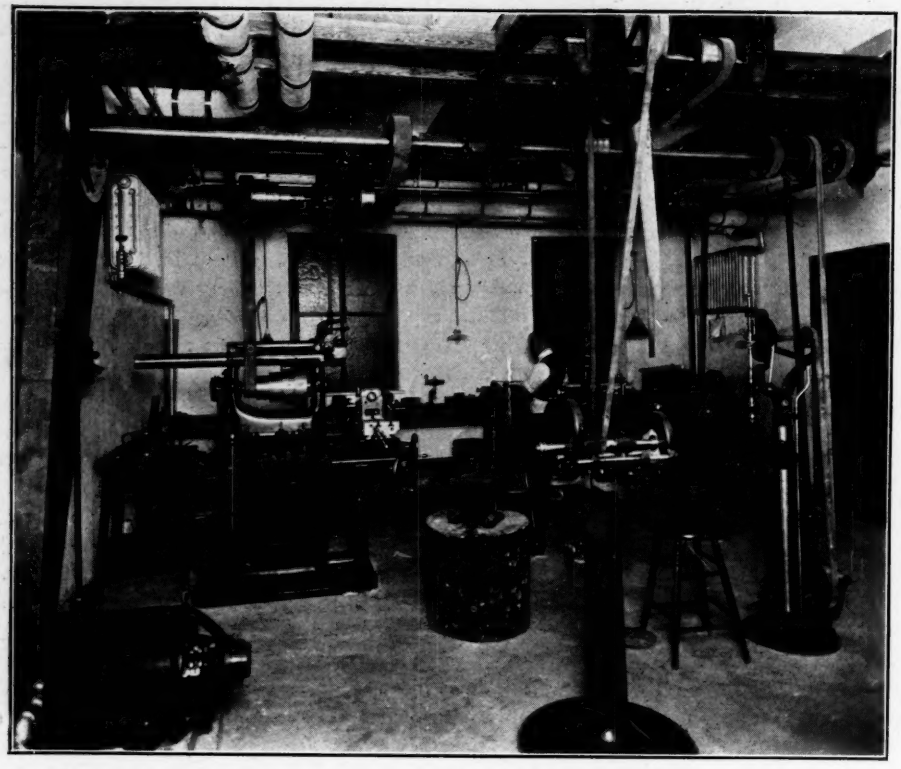


FIG. 276.—Instrument makers' workshop of the Buchanan Brady Institute.

The visitor also benefits, as, on one morning when I was in attendance, in three of the adjacent theatres Dr Halsted, Dr. Finney, and Dr. Young could all be observed at work.

The theatre used by Dr. Young is well lighted. The visitors, after being suitably garbed, occupy seats on a portable steel platform, with their backs to the light, so that an excellent view of the operation is obtained.

The anæsthetic is administered by one of the nursing staff, under the direction of a lady who is the permanent supervisor of anæsthetics. It is uniformly extremely well given, but, at the same time, one could not but feel that this arrangement did not provide the same facilities for instruction for the junior medical student as are afforded where he takes a more intimate part in the administration of the anæsthetic. There can be no doubt whatsoever that the patient benefits by this arrangement—but does the community?

The operating team consisted of Dr. Young, his first or second assistant, one of the interns as third assistant, and another doing the instruments. This latter intern is usually the most recent member of the staff, is himself a graduate, and, as has been mentioned, has spent at least two years at general surgery before coming to this department. The theatre nurse attends to the lotions, swabs, and dressings, and one or two male orderlies arrange the patient and may be employed to hold a bougie in position during the operation, or on a similar septic service.

On several occasions during our visit we saw Dr. Young perform his own operation of perineal prostatectomy. There is no doubt but that in his hands it is an ideal operation. But at the same time, it must be granted it will never become what we may describe as a cottage hospital operation.

We also saw him perform more than once his operation for tuberculous disease of the genital tract. One of these cases was a man, age 40, who had been for five years an inmate of a sanatorium. He had healed tubercle of his left lung, and on this account was operated on under a local anæsthetic, cocaine being employed. The patient was arranged in the exaggerated lithotomy position on a Young's operating table. An inverted V-shaped incision with the angle rounded off was made, the incision extending back on either side of the anal outlet from 1½ inches in front of that orifice. It was similar to that employed in doing the operation of perineal prostatectomy, except that it extended further back. The prostate having been exposed, the urethra was not, however, opened, but Young's seminal vesical tractor, which had been previously passed down to the prostatic urethra, was now introduced into the bladder, its blades opened, and the prostate pulled down. Above the prostate the seminal vesicles were exposed, and the left seminal vesicle, being found to be the site of tuberculous disease, was very carefully separated from the bladder, the vas deferens extending up from it being isolated. The vas was now divided, a pair of forceps being left attached to the lower end of the portion remaining. The wound was then packed with iodoform gauze, and closed. The next step of the operation was the removal of the diseased testicle, which was separated but for the vas, which remained undivided. By a seesawing motion, one hand holding the forceps attached to the vas in the perineum, and the other grasping it in the inguinal canal, the vas was freed and withdrawn.

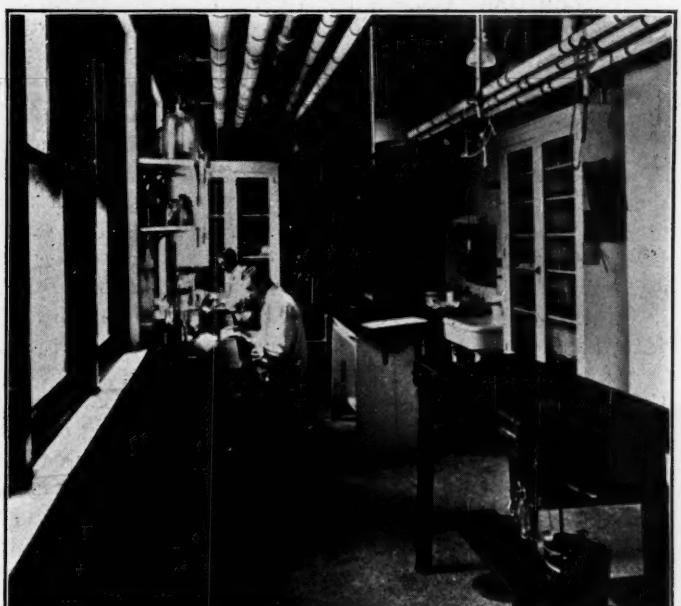


FIG. 277.—Operating rooms in the department of experimental surgery.

At the conclusion of the operating morning we accompanied Dr. Young to lunch, and perhaps in no other way could be better illustrated the fine camaraderie of the department than at this function. At its best it is a simple meal, and if you arrive late you may find little left; but here you will meet every member of the staff, and hear discussed the latest advances in the science of surgery, the latest news from a distant clinic, or even the merits of some well-known baseball team. Dr. Schwartz and Dr. Davies, who have come

down from their work in the research laboratories above, hint at discoveries that will soon be made public knowledge; and since most of the younger members of the staff, like Dr. J. C. McClelland, who is now in Toronto, and Dr. J. A. C. Colston, who served with the 15th British Division, had served in France, not infrequently the conversation turned to the war in one of its many aspects.

Dr. Young's colleague in the Brady Institute is Dr. Geraghty, and he was seen at work in the clinical examination rooms and in the operating theatre. The surgical world knows of him from many of his contributions to the science of urology, but the visitor will probably be most impressed by his wonderful clinical acumen and the soundness of his judgement on any surgical problem. Junior to Dr. Geraghty on the permanent staff is Dr. Frontz, and under his direction we had demonstrated to us several of those most interesting cases of congenital valves in the prostatic urethra that he has investigated with Dr. Young.

In one of these, a boy, 'Bobby', we were shown in the examination department the prostatic valve, and later on, in the operating theatre, it was removed. In this case the treatment was carried out by opening the bladder through a suprapubic incision, the obstruction being cut out by a specially constructed, small-sized, Young's punch, which was passed per urethram, the blade of it being driven by an electric motor.

In such a department, with such a Director, it follows as a natural consequence that many medical men who wish a post-graduate training in urology are attracted from far and wide. For these a course of training is laid down which demands a high standard of general surgical experience before they are accepted as members of the service; and thereafter they receive a special urological training, comprising work in the out-patient department, laboratory work, and extensive experience in the use of those special diagnostic and therapeutic instruments that are so frequently employed. They are also trained in röntgenography, the taking of pyelograms and cystograms. They are encouraged, and one might say expected, to devote a certain amount of their time to research. It is interesting to learn that this programme, which was initiated in the Buchanan Brady Institute, has been adopted by the American Medical Association as its own.

At the outbreak of war Dr. Young was appointed a Colonel in the Medical Corps of the United States' Army, and made Senior Consulting Urologist to the American Expeditionary Force. He accompanied General Pershing on the *Baltic* to England, and was on service in France until after the armistice. In his case the call of the bugle got a ready response from one who came of military stock, for he is the son of General William Young, and grandson of General Hugh Young, who fought in the Civil War between the North and South. When a lad of 16 years, Dr. Young, following the family traditions, joined the army, and became a first lieutenant. He soon, however, gave up the career of arms for the profession of medicine. Those who know him best will feel convinced that the same qualities that have earned for him the designation of the 'Galen of urology' would have carried him forward to a similar position of pre-eminence in the Army.

THE CLINIC OF SIR HAROLD STILES, EDINBURGH.

SIR HAROLD STILES had assured for himself world-wide recognition before he was appointed to the Royal Infirmary at Edinburgh. He had the advantage of coming to the chief hospital of the city in all the fullness of his powers and enthusiasm. For many years he had been teaching at the Children's Hospital, and from there had published, either himself or through his assistants, his chief works on surgical tuberculosis. He had the Chalmers' Hospital also and there kept his hand in, as it were, on adult surgery. A University Lectureship on Applied Anatomy—to which he was appointed, we believe, on the recommendation of the late D. J. Cunningham—had given him the opportunity of developing an aspect of surgery of which he has shown himself one of the greatest living exponents. Indeed, Sir Harold's name is known to the majority of our profession, first, perhaps, as a practical anatomist of the highest class, and secondly as an operator of very great manual dexterity.

It is with Sir Harold Stiles as a teacher rather than as an operator that we have to deal in this article. His teaching reputation has been great locally, owing to his clear-headedness and the lucidity of thought which his mind encompasses. As Clinical Professor his qualities have been given further scope, and he has the opportunity of impressing his stamp on a wider field of assistants and undergraduates. His clinic is a comparatively new one, having been in existence for only two years; for it was in 1919 that Sir Harold was appointed Professor of Clinical Surgery, and given beds in the Royal Infirmary. In this short time he has given ample proof that the magnificent tradition of teaching cherished by the Edinburgh school is being worthily upheld by him and his assistants.

Sir Harold has organized his unit at the Royal Infirmary so that it is very largely self-contained. A pathological laboratory, of which his clinical tutor is in charge, has been added; and thither all material obtained in his wards and theatre is referred and there classified, card-indexed, and disposed of in such a way that material useful for either teaching or special investigation may be conveniently obtained as occasion arises. The simpler bacteriology is also done in this laboratory, but any special bacteriological investigations are referred to Professor Ritchie's department. Obviously a self-contained laboratory of this kind is of the greatest possible value for the chief of the clinic; and his assistants are thus enabled to lay their hands at a moment's notice on material that they want, without making themselves a nuisance to others, or having to search amongst a multitude of specimens useless for their purpose. From this laboratory students are given sections of tumours or inflammatory material taken from their cases in the wards, and are allowed to keep these permanently. From time to time some special investigation will be undertaken for the students. For instance, the cervical glands removed in a case of carcinoma of the tongue will be accurately charted, and sections cut from the several glands given out to demonstrate the paths which glandular metastasis may take. Photographs and drawings are made up here for record; and these, together with a quantity of mounted and unmounted specimens, make an excellent nucleus for teaching purposes. The staff of Sir Harold Stiles' team consists of himself, assisted by Mr. D. P. D. Wilkie; Mr. Hartley as clinical tutor, on whom most of the management of the class falls; a house surgeon; and an unqualified clinical assistant.

Teaching at Edinburgh is done on six and sometimes seven days in the week. From Monday to Friday inclusive Sir Harold Stiles himself attends the Infirmary for classes or operations. It is really very difficult to draw a distinction between Sir Harold Stiles operating and Sir Harold Stiles teaching; the only difference between the two is that

on the one occasion he has a knife in his hand, and on the other he has perhaps a piece of chalk or a specimen—that is to say, he teaches incessantly, and describes the anatomical steps of all his operations as he goes along. The typical time table is :—

Monday.—A lecture at 11.0 o'clock on some selected subject.

Tuesday.—A clinic is given in the operating theatre on cases which have been specially recommended to Sir Harold Stiles, and on this day the opportunity is taken to demonstrate the case or cases destined for operation next day that have not already been shown to the students. At the same time, cases which have been operated on and which are ready to leave the hospital are also shown. The same case will, therefore, very frequently be demonstrated at length no less than three times—before operation, at operation, and after operation. The comparative dearth of clinical material at Edinburgh makes this a very valuable plan.

Wednesday.—Operations commence at 11 o'clock in the morning and may go on until 3 o'clock.

Thursday.—A clinic from Mr. Wilkie and from Sir Harold. Most of these clinics last for some 2½ hours.

Friday.—Sir Harold operates again at 11 o'clock.

Saturday.—Mr. Wilkie operates.

We have mentioned the comparative dearth of material at Edinburgh ; but it must be understood that this is entirely a relative statement. Edinburgh is by no means lacking in material, but she does not positively overflow with it in the same manner that some hospitals in the densely populated areas in England do.

Further, it is probable that we in Great Britain are making a mistake in allocating too few beds to our leaders of clinics. A service of some fifty beds is too small a number to allow the Director to allocate some branches of surgery to one or more assistants, if housing has to be found for them in a small unit. On the other hand, it must be admitted that the provision of a large number of beds would cause hardship to one's colleagues, and it is no doubt considerations of this nature that have so far prevented the institution of a British clinic on Continental lines. One cannot help being interested in speculations as to the results of such a system manned by our own people, and feeling that it would prove not only superior to the Continental models, but also far better than anything that we have to-day.

Another striking thing about Edinburgh is the extraordinary number of tuberculous cases that have to be dealt with. These cases include tuberculosis of all kinds, of bone, of glands, and of the abdomen ; also types, such as tuberculosis of the long bones, which are not commonly met with in England.

On the day that the writer was present, four cases were demonstrated to the students. Stiles is a great believer in teaching from the living body, and always, when possible, takes for the basis of his discourse some definite case or cases from the wards or out-patients. He uses the operating theatre to teach in owing to the large number of students. During the three summer months he took the whole of the women students, some eighty in number, and to these were added some thirty male post-graduates. The last simply attend the students' lectures and demonstrations in order to pick up what they can from them, as Stiles believes that his first duty is to teach the students. However, no post-graduate need be put out by this, for Stiles' clinics are so thorough that it would be difficult for anybody not to pick up hints as the hours go by.

The case is brought into the theatre ; the two students who have taken notes on the case are now called down, and one is asked to read the notes they have made. These notes are constantly interrupted to emphasize the important points which may be of diagnostic and prognostic value. The students' notes are filed away for reference with those of the clinical tutor. These notes are marked by the latter, and a record of these marks is kept on an index-card for each student. The index-cards pass from one clinic to another, so that at the end of their clinical training a definite record is in existence of

the students' practical work, and at the final examination this record may turn the scale for or against the student in doubtful cases. This is surely a very admirable method, and one worthy of wide application.

The first case shown was one of tuberculosis of the left kidney. The history was brought out by question and cross-question, and, finally, Stiles reviewed the whole case in a judicial summary.

When special examinations are referred to, such as animal inoculation for tuberculosis, and cystoscopy, Stiles does not simply mention these things and pass on, but he requires the students to tell him exactly what technique is employed for the inoculation of tuberculosis into animals, what one would expect to find, when one would expect to find it, and what method can be employed to speed up the positive reaction.

In a case of cystoscopy, the appearance of the bladder and ureteral openings are gone into clearly and concisely. Needless to say, a very great deal of surgical anatomy

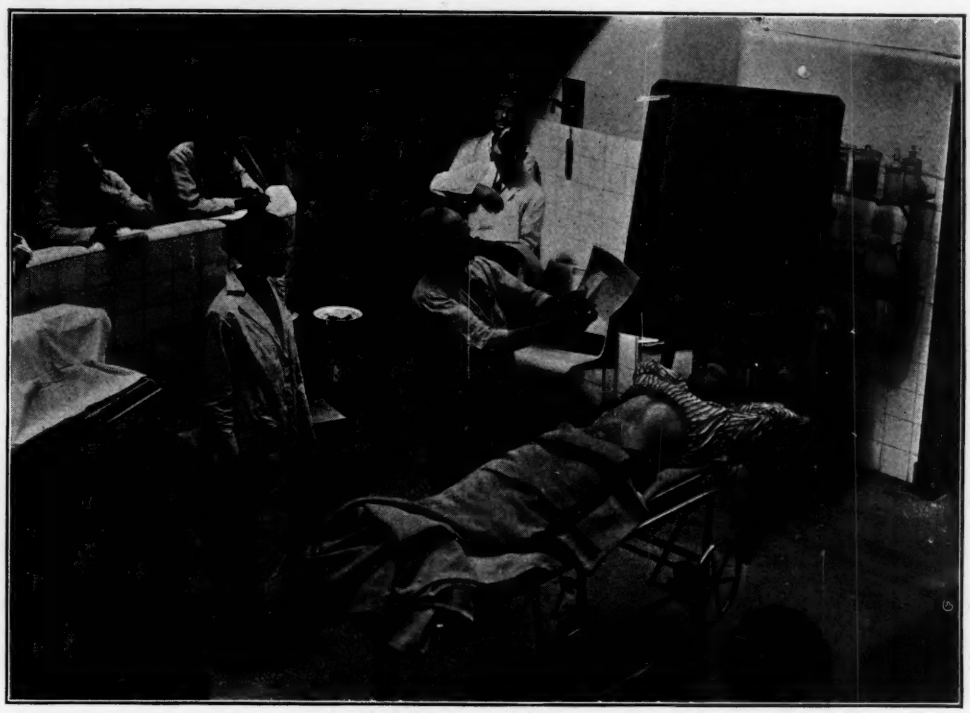


FIG. 278.—A clinical demonstration in the theatre.

is interspersed throughout the clinical discussion of the case. This is, indeed, one of the most striking features about Stiles' method of teaching. He insists on an accurate knowledge of normal anatomy, and works anatomy into the case all along.

There may be those who believe that the teaching of anatomy can be carried to excess, the excess being reached when physiology is excluded; but Stiles succeeds in avoiding this exclusion of physiology, and shows a very careful discrimination of what points in anatomy are likely to be of value in the elucidation of the treatment of the case.

The second case—tuberculosis of the kidney—which had been operated on three weeks previously and was now ready to leave hospital, was demonstrated. In this case Mr. Wade had performed ureteral catheterization, and had reported that the ureteral catheter had stopped at 20 cm. Stiles immediately asked, "How far should it go?" and there was no answer. Stiles said that their information was of no use to them unless they knew approximately at what anatomical level along the ureter its passage had been arrested.

In the examination of the patient the first thing that the student was asked to do was to map out the kidney pelvis from the front. Stiles himself then demonstrated the best method of palpating the kidney, and the best method of eliciting kidney pain. He finished up by a rapid synopsis of the spread of genito-urinary tuberculosis, and by showing specimens of tuberculous kidneys from the laboratory.

The two students who were down stood for one and a quarter hours whilst all these points were being gone into; but so great is Sir Harold's grip of the students' needs, and so clear is his method of demonstrating cases, that the picture never for one moment in all this time became clouded by the discussion of unnecessary details, or insistence on unimportant points. One is impressed by the teacher's very great patience. The case is examined and discussed in a most leisurely manner. The students are not bullied or harried, and Stiles is apparently willing to wait an indefinite time for an answer. Every now and then he will break in on the student's description with some vigorous comments on the case, emphasizing his points in his enthusiastic way by repeated gesticulations

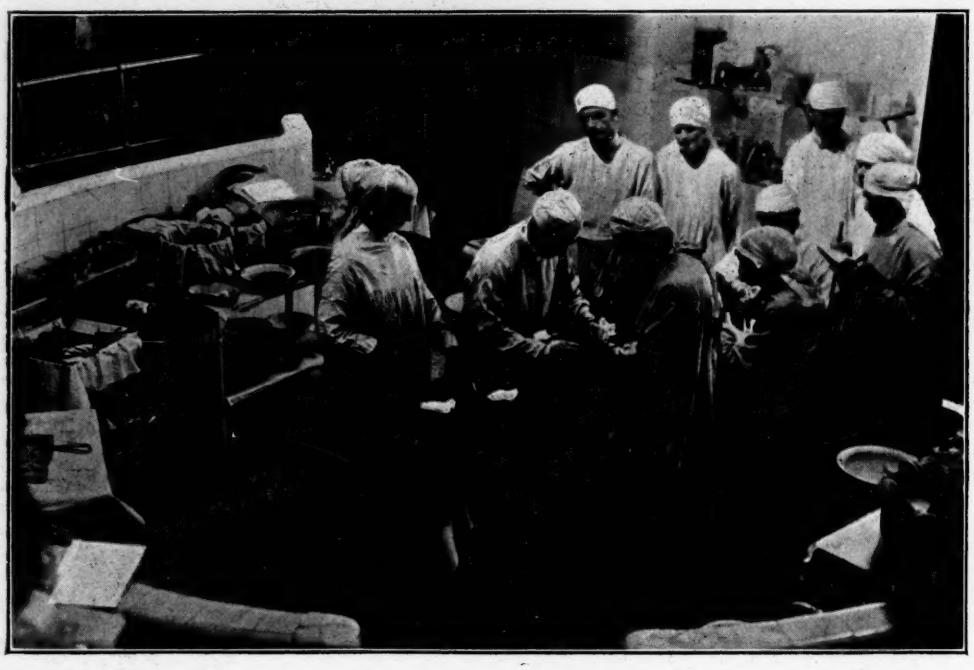


FIG. 279.—An operation.

with his hands. There is nothing strained about it, nothing sensational, and there is an entire absence of ' playing to the gallery '.

A number of the students present were juniors who had not yet done any pathology, and Stiles told them, " I do not expect juniors to know any surgery, but I expect them to tell me what they see "; and strictly does he make them live up to this requirement.

The third case was one which too many surgeons would scarcely have thought worth showing, an ancient case of osteomyelitis of the radius. In this case the blood-supply of bone, medulla, epiphyses, and metaphyses was gone into. The anastomosis round the joint was described; none of the students knew its technical term, and were left to find out for themselves what it was called. Hæmogenic infections were then discussed, and the cause of the settling of organisms in bone ends. It is rather curious to hear the term 'new case' used for involucrum (an ugly word), the old-fashioned phrase being still retained at Edinburgh. Finally, of course, the surgical anatomy and the operation for exposure of the radius were discussed, and the structures enumerated which it is one's duty to avoid.

Lastly a case of tuberculosis of the rib was shown, together with the specimens of two ribs which had been removed from the case previously. Here the student in charge of the case was called down, and had to discuss the pathology of rib tuberculosis, and how it differs from tuberculosis of bone elsewhere; the surgical anatomy for the operation of exposure of a rib; and had to read an account of what was done in this particular case.

This concluded the morning's clinic, which had lasted for three hours.

Stiles has instituted a quarterly class examination which his clerks have to take. This is conducted by Mr. Wilkie and Mr. Hartley. The questions are set on such cases of value as have been in the wards. The students are expected, in discussing the treatment of these cases, to give such methods as have been employed in the wards during their time; and no marks whatever are given for purely text-book answers, or even for discussion of alternative methods of what might have been done if the case had been a little different. The object of the examination is to find out to what extent the students have observed and retained in their memories a case seen, and the surgical steps taken. A medal is given for this examination. The ideal aimed at in the clinic is one of intense observation on the part of the student, and a sound memory of the case that he has seen. To this end demonstrations of the same case before and after operation, more than once, is of great value. This may sound somewhat dull, but in practice it is surprising how interesting and how important the second demonstration can be.

On Wednesday Stiles operated, first on a case of old-standing ulcer of the pylorus; doing a posterior gastro-enterostomy with fine thread. The operator used a mid-line epigastric incision, examined the ulcer, and removed the largest of the sub-pyloric glands; he then very rapidly tore through the gastrocolic ligament and exposed a large mass of glands on the deep surface of the pylorus. These were removed and immediately cut into, but showed no sign of epithelial metastases. It was interesting to note that these glands had given an erroneous impression to the fingers as to the size of the pyloric mass, the major part of which was due to these enlarged glands. He then proceeded to do a gastro-enterostomy. He tore through the gastrocolic ligament about its middle; the transverse mesocolon was then opened on his fingers in the usual manner and a selected piece of the jejunum drawn through. This method corresponds closely with that which Victor Pauchet has popularized, but Stiles seems to have priority in this, as he has been doing it for many years. He points out that this is the anatomical method of doing a gastro-enterostomy, and that if one asked a student to expose the posterior surface of the stomach, he would never dream of going through the mesocolon, but would certainly proceed to open the gastrocolic ligament. The point in favour of the latter opening is that one certainly does get a better view of the posterior surface of the stomach than one does by the ordinary method. In some difficult cases it is easier to make a better selection for the site of the anastomosis by this method, as one is bringing the jejunum up to the stomach rather than pulling the stomach down to the jejunum. The anastomosis is made in the ordinary two-layer manner. Stiles lays great stress on the closure of his abdominal incisions, and turns inwards the inner margin of the rectus sheath on both sides in the manner which he describes in the section on surgical anatomy in Cunningham's text-book.

The next case was a large diffuse non-toxic adenoma of the thyroid of which the right lobe had been removed some years previously. The first step in this case was the ligature of both thyroid arteries, first the superior and then the inferior, by de Quervain technique at the inner border of the carotid sheath. Owing to the large size of the gland this was by no means an easy step; but all through, the anatomy of the operation was reviewed and kept constantly before the students. After these ligatures had been done, a wedge resection was made; but in spite of the vessel ligatures there was a good deal of hæmorrhage, which was, however, fairly readily stopped by clips and hot saline packs, and ceased entirely when the cut edges were whipped together. Stiles as a rule uses intratracheal insufflation for his thyroid cases. For his tuberculous glands in the neck he uses chloroform as a routine, as also in his breast amputations. With chloroform he believes he has much

less hæmorrhage than with ether. The chloroform tradition is not nearly so strong now in Edinburgh as it has been in the past, and except for such special cases as these the anæsthetist uses what anæsthetic he prefers, usually open ether.

The third case was nephrectomy for the tuberculous kidney demonstrated the previous day. For this his patient was flat on his face, and Stiles made a vertical posterior incision, removing the twelfth rib. He pointed out that this incision enables the operator to deal with the hilus most rapidly: the further he carries the incision round the flank laterally, the further he is going away from the vessel pedicle. The twelfth rib is removed as a routine, giving a clear exposure of the upper pole of the kidney, and thus rendering easy what is sometimes a difficult dissection. The anatomy of this approach was demonstrated to perfection.

A reputation as a surgical anatomist is not always easy for a surgeon to live up to in practice; but there can be no question of Sir Harold's right to be called an applied anatomist of the very highest class. He not only knows just where structures are, but is able to demonstrate them without blunt dissection. He goes straight to the spot with the knife-edge. His knowledge of the lie of the land in the neck is very unusually complete, as anyone who has seen him dissect tuberculous or malignant glands will admit. He uses a variety of incisions for these operations according to the character of the case. The J-shaped incision is not commonly used, but great stress is laid on the mobilization of both anterior and posterior borders of the sternomastoid. A further point is that when disappointing results follow the radical operation for tuberculous glands, the commonest site for gland survival is the point of exit of the spinal accessory nerve at the posterior border of the sternomastoid. Stiles prefers to go through the mid-line of the abdomen, but he insists on an unusually careful closure of the incision. He uses interrupted sutures a great deal. He is one of those who never drain a collection of pus through the rectus sheath. He has a special plan for the closure of the flaps after radical amputation of the breast, cutting the inner flap at right angles for some three or four inches; it is remarkable how this manœuvre facilitates suture in a difficult case. His vertical incision in kidney cases has already been referred to; if it is necessary to resect the ureter, this is done through a separate incision low down in front.

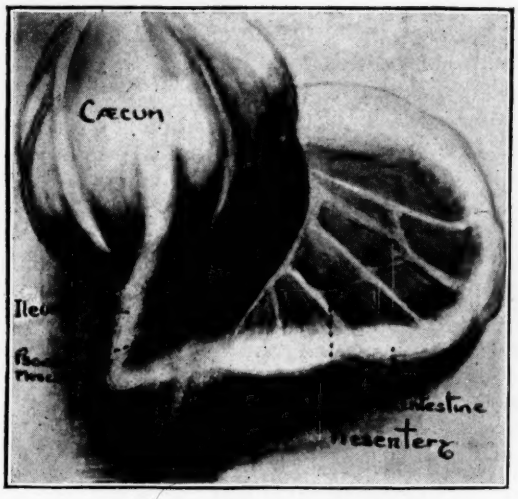
In the person of Sir Harold Stiles the true general surgeon reaches his zenith. During the war he became interested in orthopædics, and has worked to great advantage in that field; his long experience of children undoubtedly stood him in good stead here. He is not one of those on whom the abdominal walls have closed, and this is surely due to his exceptional knowledge of structural anatomy which causes him to revel in dissections of regions from which only too many are anxious to escape. His spare figure; the quick movements of his hands, almost Gallic in their nervousness; the slight and rather charming huskiness of his voice; his quizzical smile; and above all the intense enthusiasm which seems to burn in him, all go to make up a personality which one quickly recognizes as far from ordinary. Sir Harold appears to possess a further something that is a gift, which a man either has or (too often) has not—an ability to inspire, and above all to encourage, his juniors. When Sir Harold Stiles goes, there will not only be a mantle to descend, but there will be disciples for it to descend upon.

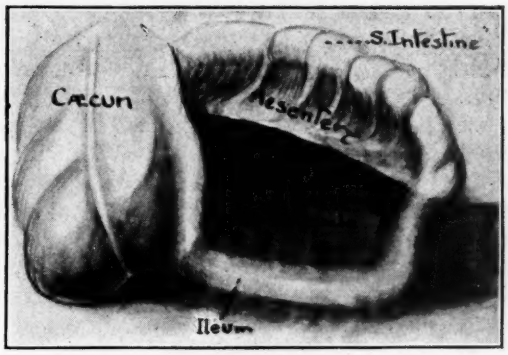
DEFICIENCY OF THE MESENTERY OVER THE LOWER ILEUM.

By GEORGE E. ARMSTRONG, Montreal.

By one of those strange coincidences that we are all familiar with, the two patients presenting the rare anomaly that I now report were in the Royal Victoria Hospital, Montreal, at the same time. The anomaly consists in the absence of a mesentery for the terminal six or seven inches of the ileum (*Figs.* 280, 281).

My own case was a man, age 33 years, sent up to me as a case of recurring appendicitis. He gave a history of having had three attacks at intervals of a month or six weeks. The outstanding feature in his history was the severity of the pain during the attacks. He told us that during the last illness, from which he was just recovering, morphia failed to give relief, and that he had been kept under the influence of ether from 11 p.m. until 6 a.m. the following day. He referred all his trouble to the region of the appendix, and on admission the right lower quadrant was definitely tender. Seventy-two hours after





Figs. 280, 281.—Showing absence of mesentery at terminal part of ileum.

admission I proceeded to uncover the region of the appendix. The condition observed on opening the abdomen was most unusual. The cæcum was very mobile, and on pushing it and the ascending colon inwards, the tissues outside the colon were found to be hæmorrhagic, ecchymosed, and at one spot the peritoneum was found lacerated. The appendix was curled up external to the ascending colon, and retroperitoneal. It was congested. The area external to the colon looked almost exactly as if he had been kicked with a heavy boot. The terminal six inches of the ileum was subperitoneal. The deficiency in the mesentery began in the pelvis in front of the sacro-iliac synchondrosis, about an inch below the brim. From this point the ileum passed up over the external iliac vein and over the psoas muscle to its junction with the cæcum. It was very intimately adherent to the wall of the external iliac vein by means of normal tissue. There was no sign of inflammatory action. The appendix was removed, and cæcum and ascending colon were sutured to the outer abdominal wall by three rows of sutures. So far there has not been any recurrence of symptoms.

The other case was discovered at autopsy. The patient had been under the care of

one of my colleagues for a condition not associated with the anomaly. On tracing the small gut downwards, it was found to be free from adhesions or exudate, and apparently ended suddenly at the brim of the pelvis over the right sacro-iliac joint. On lifting up the cæcum, which was markedly dilated, it was found to be very mobile, with a definite mesocolon, and to be apparently disconnected from the ileum. This was due to an anomalous condition of the last six inches of ileum. The mesentery ended abruptly at the brim of the pelvis over the right sacro-iliac joint, where the ileum became retroperitoneal and ran posteriorly across the iliopsoas muscle, then turned upwards for nearly three inches, and lay in the groove between the iliopsoas and the quadratus lumborum. It then reached the posterior surface of the cæcum, on which it ran downwards for about two inches to approximately its normal insertion at the ileocæcal valve. In this manner, with the cæcum in its normal position, it ran a course forming a loop with rather a sharp turn or kink at its point of junction with the posterior aspect of the cæcum. This whole loop, when the cæcum was first lifted up, was completely flattened, and so not noticeable; thus causing the appearance of the abrupt ending of the ileum at the pelvic brim. Manipulation of the small gut and cæcum caused this loop to fill with gas and come into view. It is probable that the anomaly caused a partial obstruction under certain favourable conditions.

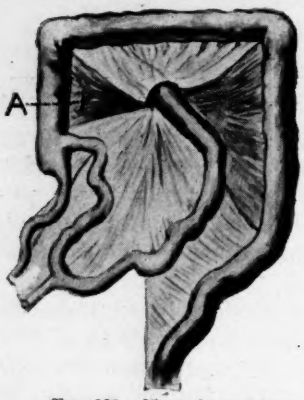


FIG. 282.—Normal mesentery. (A) Normal extent of fusion of mesocolon to posterior abdominal wall.

It is interesting to note that since these cases were observed, Professor Whitnall (Anatomy) and Professor Simpsom (Histology and Embryology) have found two similar conditions in 50 bodies in the dissecting room of McGill University. In these latter there was no clinical history, and no evidence that the anomaly had contributed to the death.

The only similar cases that I have found recorded in medical literature were reported in May, 1890, and published by W. H. Bennett, Surgeon to and Lecturer on Anatomy at St. George's Hospital, and Rolleston,[1] Curator of the Museum. They reported three examples of the anomaly, their attention being called to the condition by the fact that it

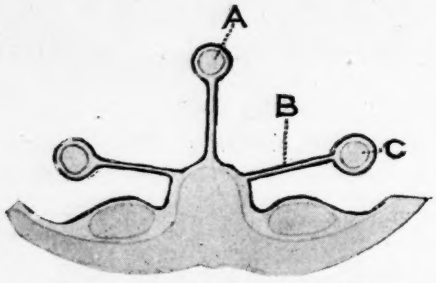


FIG. 283.—Character of the mesocolon in the fœtus. (A) Small intestine; (B) Mesocolon; (C) Ascending colon.

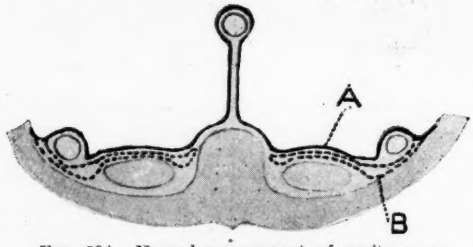


FIG. 284.—Normal arrangement of peritoneum; showing changes which occur in the fœtal mesocolon. (A) Ascending mesocolon fused to posterior abdominal wall; (B) Peritoneal layers which are obliterated.

was "associated with, and probably instrumental in producing a fatal twisting of, the lower part of the ileum". The cases that were observed in the Royal Victoria Hospital differed from those reported by Bennett and Rolleston in the length and mobility of the cæcum and ascending colon. In their cases the cæcum had not descended into the right iliac fossa, but lay over the right kidney. Moreover, the cæcum was small and of the fœtal type.

Normally, the ascending mesocolon of the fœtus is flattened against the posterior abdominal wall on the right side, and fuses with the parietal peritoneum over the area shown in *Fig.* 282. Over this area the posterior layer of the fœtal mesocolon and the fœtal parietal peritoneum are obliterated, and the anterior layer of the fœtal mesocolon

becomes the parietal peritoneum of the adult. This is shown in *Figs.* 283, 284. This fusion of the ascending mesocolon normally begins at the level of the right colic flexure and extends downwards. In the cases described, this fusion has apparently extended low enough to include the mesentery of the terminal part of the ileum, as shown in *Fig.* 285.

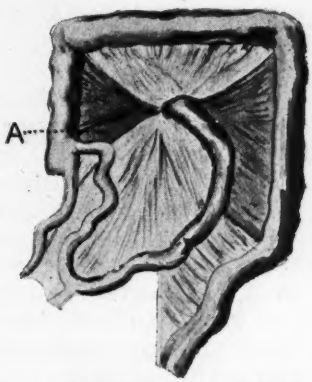


FIG. 285.—Showing terminal portion of ileum unprovided with mesentery. (A) Extension of area of fusion.

A very possible cause of this extension of the area of fusion is the presence in the fœtal stage of a 'genito-mesenteric fold' (*Fig.* 286), which, by putting traction on the developing mesentery, may cause a fusion of the ileum to the posterior abdominal wall. Douglas G. Reid describes a 'genito-mesenteric fold' found in 11 of 20 fœtuses examined. It passes from the inferior surface of the mesentery in the right half of the abdomen, forming an anteroposterior septum lying in the vertical plane, and incompletely dividing the portion of the abdominal cavity below the root of the mesentery into two compartments. The smaller of these is on the right side and contains the cæcum, the larger on the left contains the pelvic colon. The fold is triangular, and has two attached borders (superior and posterior) and one free (inferior). The posterior border is attached to the posterior abdominal wall along the line of the right spermatic or ovarian vessels. The superior, or mesenteric, border is attached to the inferior surface of the mesentery, often to a considerable extent. This attachment to the mesentery is generally exactly along the line of the iliac branch of the ileocolic artery. The upper part of the fold may persist as the free edge of the duodenorenal ligament of Huschke. Its lower part may persist in the adult, forming the medial boundary of the retrocolic fossa, passing from the ileum or appendix. It is the commonest cause of a retrocolic position of the appendix. "The fold may also assist in producing adhesions of the duodenum, cæcum, and ileum to the posterior abdominal wall. Adhesion in the adult, binding down the terminal part of the ileum, the cæcum, the appendix, the mesentery, the meso-appendix, and even the 'bloodless' fold of Treves, need not be the result of pathological changes, unless the natural causes we have indicated for the adhesion can be excluded, although a genitomesenteric fold may not always be seen, even in the fœtus" (p. 82).

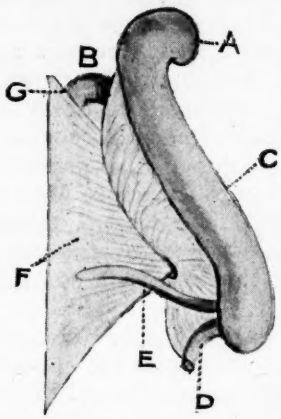


FIG. 286.—Showing 'genito-mesenteric fold'. (A) Transverse colon; (B) Duodenum; (C) Ascending colon; (D) Ileum; (E) Appendix; (F) Genitomesenteric fold; (G) Duodenorenal ligament.

REFERENCES.

[1] BENNETT and ROLLESTON, *Jour. Anat. and Physiol.*, xxv.
[2] REID, DOUGLAS G., "Studies of the Intestine and Peritoneum in the Human Fœtus," (6 figs.), *Ibid.*, 1911, xlv, 74.

CLEFT PALATE:
THE ADVANTAGES OF A TWO-STAGE OPERATION.

By THOMAS H. KELLOCK, London.

If one may judge by the number of cases of cleft palate that come for treatment for which previous unsuccessful or only partially successful operations have been performed, it is evident that the result of those operations must have been disappointing in many cases. This is greatly to be deplored, because it is the first operation that offers the best prospect of success; when previous operations have been performed the tissue to be dealt with subsequently has been reduced in quantity by the paring of the edges; scarring has rendered them less elastic than normal; and previous experience of a somewhat painful ordeal has made the child intolerant of further interference.

It is not my intention to discuss the age at which the operation should be done; I have seen no reason to change an opinion held for many years, that the proper time to operate for cleft palate is "the earliest age at which one can reasonably hope to obtain primary union by symmetrical suturing in the middle line". This age, which varies a little with the degree of the cleft and the general development of the child, is generally between two and three years; if at or about that age one is fortunate enough to have to deal with a case that has not previously been damaged by unsuccessful operation, success ought to be more common than failure, and the object of this paper is to advocate a method of operating which in my hands has given much better results than I was able to obtain before adopting it.

In cases where the cleft involves the soft and the whole or part of the hard palates, failure after operation may be total or partial. In the case of total failure the cause is often a constitutional one, the general condition of the child preventing primary union; and this is often the result of a lengthy and severe operation. In the case of partial failure—which is the more common—the cause I think is to be looked for locally. The spot at which failure generally occurs is at the junction of the hard and soft palates. At this spot the palate is thinner than elsewhere, and the soft palate, covered with mucous membrane above and below, has to be joined to the mucoperiosteal flap that has been raised from the hard palate and is covered with mucous membrane on its lower aspect only. The most potent cause of failure at this spot is, I think, ischæmia of the parts, which is brought about by the lateral incisions that are made in order to bring the two halves of the palate together. In the making of these incisions the posterior palatine artery or several of its principal branches must necessarily be divided, and so temporarily the central part of the palate is deprived of a good deal of its blood-supply and is therefore not in a good condition to unite by first intention; from the natural colour of the parts this effect of the incisions may not be noticeable during the operation, and the somewhat ischæmic edges may be still further damaged by the insertion of sutures. It is chiefly to obviate this cause of failure that the operation has been divided into two stages with the object of ensuring good circulation in the lateral portions of the soft palate before they are sutured together.

Before proceeding to operation there are a few details in the management of the patient, attention to which goes a long way in securing success. It goes without saying that the child's general state of health should be at any rate fairly good: in such an operation as this it is hopeless to expect a satisfactory result unless the power of healing is good, and this can only be obtained by a healthy condition of the patient. In addition, the child should be happy; success is hardly to be expected if he is miserable and discontented after the

operation. During a week or so of observation previous to operation the child should be fed and treated exactly as he will be afterwards, so that the operation may make as little difference as possible in his daily life. As regards feeding, I have relaxed very materially the rigid rules formerly laid down, and have allowed quite a liberal diet both before and after the operation. When the latter has been performed the child will continually be swallowing saliva and mucus, and there can be no harm in his swallowing some food as well. Children at this age often have very good appetites, and cutting down their usual liberal diet makes them unhappy and miserable; allowed to feed themselves with a spoon they may with safety take as much soft or finely minced food as they want. One may relax, too, the old methods as regards the bowels; if they are acting naturally nothing at all need be done in the way of aperients or enemata; if this is not the case and constipation is present, during the week previous to the operation mild doses of aperient should be given regularly, and continued after the operation; for it is the onset of the need of an aperient that harms the palate, and when once this is obvious the damage has been done and cannot be remedied.

The two-stage operation is carried out as follows in a case where the cleft involves the soft and the whole or part of the hard palates. At the first operation mucoperiosteal flaps are raised as usual from the hard palate through the small incisions A A (*Fig.* 287), and the attachment of the soft palate to the hard is divided. These lateral incisions A A can

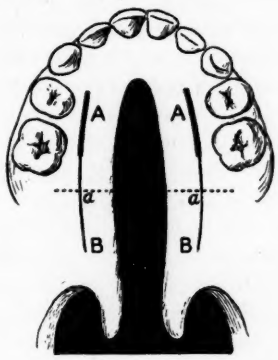
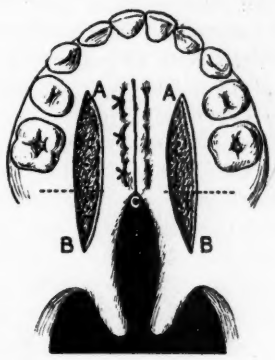


FIG. 287.



The dotted line represents the position of the posterior edge of the hard palate.

FIG. 288.

then be prolonged well back into the soft palate to B B, cutting through the mucoperiosteal flaps from A to *a* where the hard and soft palates joined, and through the whole thickness of the soft palate from *a* to B. The mucoperiosteal flaps from the hard palate can now be sutured in the middle line, and if they meet with a little to spare—as is generally the case—there is no need to freshen the edge, for the posterior (or upper) surface being raw when raised from the bone, they can, by the insertion of square stitches, be backed against each other and leave more or less of a frænum in the middle line.

This completes the first stage of the operation: if the halves of the soft palate are slack there is a very great temptation to go on and complete the operation at the one sitting; but this should not be yielded to, and the parts should be left in the condition shown in *Fig.* 288, the shaded parts A B representing the opening out of the original incisions —nothing has been done to the edges of the soft palate.

This may have been a fairly severe operation, but the hard-palate flaps generally unite easily, there being no muscle in them to draw them apart, and they are well supplied with blood from the front of the palatal arch; and the ultimate success of the operation does not materially depend on the child's general condition for the next day or two. As a rule they feel the effect of this part of the operation much less than one would expect.

It is well to inspect the mouth about the third day after, and it will generally be found

that the lateral incisions A B have almost closed over again; these can then be gently re-opened with some blunt pointed instrument.

At the end of a week the circulation of blood in the two halves of the soft palate will have become well established from the ends, and the second part of the operation can be done. The sides of the soft palate will be found quite vascular and somewhat thickened, the latter a distinct advantage in the freshening and suturing of the edges.

All that has to be done at the second operation is to freshen the edges of the soft palate and insert the sutures, and provided the knife and needle are quite sharp (an essential point) this can be done very quickly. An important point in freshening the edges is to be sure that it is properly done at the point C (*Fig.* 288) where the hard and soft palates join; any doubling in of mucous membrane at this spot will surely prevent complete union, and it is often a help to re-open a small portion of the already sutured hard palate to ensure entire freshening at this spot. This very short operation—on which so much depends—upsets the child but little; he is already accustomed to the feeling that something has been done in his mouth, and it is generally possible to let patients be up and leading their ordinary lives on the following day.

The advantages of this two-stage method are that at the first operation most of the work is done, and comparatively little harm can come even if the child be upset by it; and that the lateral incisions can be made very freely if necessary so as to render the subsequent approximation of the two halves of the soft palate quite easy. The interval between the operations allows the circulation in the sides of the soft palate to be well established from the ends, and this circulation is not interfered with at all at the second operation.

The second operation is a simple and short one; there is a minimum of hæmorrhage; and it upsets the child little, if at all, and so gives the palate the best possible chance of complete union by first intention.

INSTRUCTIVE MISTAKES.

DILATED STOMACH TAPPED IN MISTAKE FOR PERITONEAL EFFUSION.

J. S., a married woman, age 42. Had had a short illness of about 6 months' duration, in which she had suffered from pain, loss of flesh, and slight jaundice.

On Examination.—She was thin, and jaundiced—the stools were light-coloured but not devoid of pigment. There was no vomiting; appetite was lost, and she complained of a dull heavy pain in the epigastrium lasting many hours after food. The abdomen was thin and flaccid, and there was an indefinite resistance in the right hypochondrium.

Operation, Sept. 6, 1920.—The abdomen was opened through the right rectus muscle. A tumour involving the head of the pancreas was felt, and the gall-bladder was moderately distended. The stomach and proximal part of the duodenum were normal. A diagnosis of malignant disease of the head of the pancreas with early involvement of the bile-duct seemed obvious, and a cholecystenterostomy was performed between the fundus of the gall-bladder and the first part of the duodenum. The wound was closed without drainage.

For two days after the operation the condition was satisfactory. On the third day she complained of pain, the pulse gradually rose, and the abdomen became uniformly distended. She had no vomiting; the bowels were opened slightly after an enema. The next day the distention and distress were more marked. The abdomen was globular, hard, tender, and dull to percussion. It was thought that the physical signs pointed to peritonitis with a low grade of infection, probably due to a leaking of bile from the anastomosis. Under an anæsthetic, a medium-sized trocar was thrust into the abdomen to the left and below the umbilicus. Several quarts of thin bilious fluid with a large proportion of mucus escaped, and then the fluid contained some small milk clots and some grape seeds, revealing the fact that the trocar had penetrated the stomach. The abdomen was opened by a vertical incision through the aperture of puncture, the stomach was drawn up into the wound, and the trocar opening closed by suture. The stomach appeared almost to fill the abdomen. A posterior gastro-enterostomy was done, but the patient succumbed within a few hours. No autopsy was obtained.

The two unusual features about this case were the absence of vomiting, and the dullness to percussion of the stomach. No doubt it was a paralytic acute dilatation of the stomach, and if a tube had been passed, the nature of the condition would have been recognized, and possibly disaster would have been averted.

FATAL HÆMORRHAGE DURING NEPHRECTOMY FOR A HYPERNEPHROMA.

J. H., a robust man, age 49, had had two attacks of painless hæmaturia during the month preceding admission. In the last of these, several worm-like clots had been passed. The cystoscope showed that the blood was oozing from the right ureter. The right kidney was just palpable through the stout abdominal wall.

Operation, July 7, 1921.—The right kidney was exposed through the usual incision; but, owing to the thickness of the parietes, it was found necessary to excise the 12th rib, in doing which the pleural cavity was opened. The kidney was then brought out of the wound. The organ was enlarged to about one-third more than the natural size, by a vascular growth occupying its upper pole. The pedicle was easily isolated; its three main

constituents were defined; the artery, vein, and ureter were separately clamped; and the kidney was removed. The duct and vessels were then tied in order from below upwards, there being no difficulty with the ureter or artery. On drawing up the large vein preparatory to ligature, the forceps came away, the vein being torn through proximal to the clamp. There was a furious hæmorrhage, which was only checked by gauze plugging. The most careful efforts at compression of the inferior vena cava, followed by removal of the gauze, enabled the stump of the renal vein to be found and secured; but by this time, in spite of transfusion, the patient was dead.

It is easy to read the moral of this mistake. The vein was delicate, and the abdominal walls were thick. A ligature should have been passed round the pedicle as a whole, or round the artery and vein, or else the vein should have been ligatured first.

DIVISION OF THE PELVIC COLON IN A LEFT-SIDED SLIDING HERNIA: DEATH A YEAR LATER FROM INTESTINAL OBSTRUCTION AFTER CLOSING OF COLOSTOMY.

H. H., a labouring man, had suffered from a large left-sided inguinal hernia for some years. He was fat, but otherwise healthy.

OPERATION, Aug. 10, 1920.—An operation for the radical cure of the hernia was done. On opening the sac, several coils of small gut were found and replaced in the abdomen. The neck of the sac was obscured by a large mass of fat which closely enveloped the cord. This was dissected free from the cord, ligatured, and cut away. The stump of the fat mass was then seen to contain two cut pieces of colon. The ligature was cut, and an end-to-end suture of the divided bowel undertaken. The wound was closed in the usual way.

Three days later the patient's condition was that of intestinal obstruction with distention and vomiting, and a colostomy of the transverse colon was done to relieve this. For six months the colostomy was allowed to operate; but as the patient several times passed motions by the rectum, an attempt was made to close the colostomy by dividing the spur by means of an enterotome. This did not succeed, and although the colostomy opening became less prominent and bulging, there was no more passage through the rectum. He was re-admitted in August, 1921, and subjected to *x*-ray examination after an injection of barium mixture into the colon through the colostomy, and into the rectum through the anus. The result of this examination showed what appeared to be a continuous column of barium, and there was no evidence of stricture or kinking.

OPERATION, Aug. 30, 1921.—The colostomy wound was closed by separate layers of sutures, taking the gut first and then the parietes. On Sept. 1 his condition was satisfactory, but no flatus had been passed by the rectum. The next three days he gradually developed symptoms of obstruction, and on Sept. 4 these were so unmistakable that the colon had to be opened at the colostomy; but, unfortunately, this was done too late, and the patient died the next day.

The two mistakes in this case were: (1) The failure in the first place to recognize the nature of the fat mass in the neck of the sac, which was a sliding hernia containing a part of the pelvic colon. (2) In the second place it is clear that the *x*-ray evidence of continuity of the passage in the large intestine was unreliable; probably the colon was bent upon itself just at the site of stricture, so that the shadows of the gut proximal and distal to the lesion were superimposed but not really continuous. It would have saved the final disaster if the abdomen had been opened in the mid line and a short-circuit operation performed, excluding both colostomy and the site of the stricture.

SHORT NOTES OF RARE OR OBSCURE CASES.

FIBROMA OF THE MESENTERY.

By H. G. KYLE, Bristol.

A tumour of the mesentery is a somewhat rare affection, and, the diagnosis being generally difficult to make, it may be of interest to record a recent case under my care at the Southmead Infirmary. I can find few records of similar conditions, though several instances of cysts, dermoids, and sarcomata of the mesentery have been found.

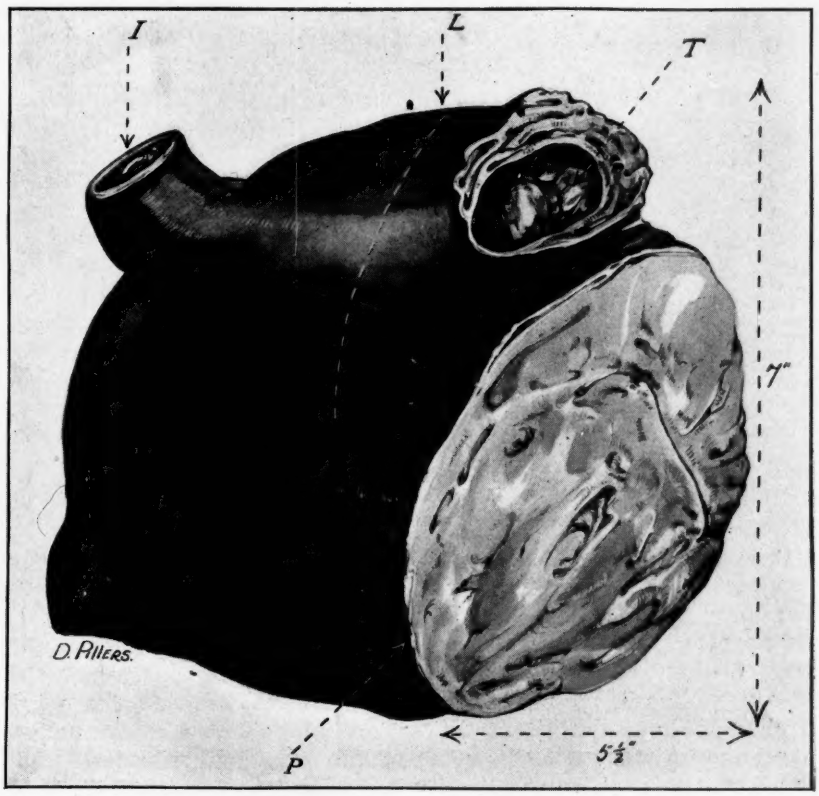


Fig. 289.—Specimen after removal. *I*, Distal end of portion of bowel involved by growth. *T*, Tumour growing into lumen of bowel. *P*, Cut edge of peritoneum. *L*, Line of section of tumour as shown in *Fig.* 290.

A. D. Bevan[1] gives an account of a large fibroma he removed from the mesentery. W. J. Greer,[2] having had such a case, searched the literature of the subject and was only able to find accounts of 32 others in the past 90 years. He gives a very instructive description of his own case, with details of all those previously recorded.

My patient, a male, age 40, had for about a year complained of abdominal pain and increasing constipation. In November, 1920, he noticed an increase in the size of his abdomen, and went to the General Hospital, where he was advised to come in for further examination; but feeling better and fearing the possibility of an operation he did not come.

He was admitted to the Southmead Infirmary in February, 1921. I saw him there, and found a large tumour in the hypogastrium feeling and looking very much like a distended bladder. It varied very much in size and position from day to day; sometimes it was not to be felt, but when felt was always in the same position, and could be palpated bimanually with a finger in the rectum. He was seen by several surgeons, who were unable to make a certain diagnosis, although the possibility of its being a mesenteric tumour was suggested by one.

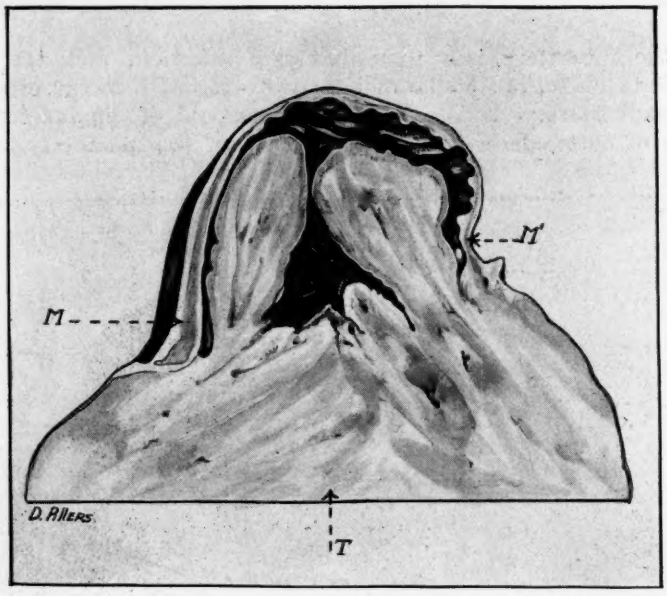


FIG. 290.—Fibroma of the mesentery. *M*, *M'*, Muscular wall of gut. *T*, Tumour projecting upwards as two polypoid masses into the lumen of the gut.

OPERATION.—On Feb. 11, 1921, I opened the abdomen and found a large tumour growing in the mesentery of the ileum. The intestine was tightly stretched across and intimately connected with it; outgrowths of the tumour could be felt projecting into the lumen of the bowel. It was somewhat vascular in appearance, and suggested a sarcoma. It was freely movable, and when displaced slipped right up into the upper abdomen.

I resected about 6 inches of ileum and removed the tumour, which weighed 3 lb. (*Fig.* 289). On section (*Fig.* 290) it had just the appearance of a uterine fibroid. Professor Walker Hall examined it, reporting it to be a simple fibroma, not sarcomatous. The patient was much relieved by its removal, his abdominal pain disappeared, and the bowels now act regularly. Two months afterwards he had put on 12 lb. in weight.

The drawings of the tumour were made for me by Miss Pillers.

REFERENCES.

[1] BEVAN, *Surg. Clin. Chicago*, 1918, ii, 478.
[2] GREER, *Brit. Med. Jour.*, 1911, Oct. 28.

FIBROMA ARISING IN THE PALM OF THE HAND.

By NORMAN HODGSON, Newcastle-on-Tyne.

Tumours of any description in the palm of the hand are of rare occurrence. A fibroma in this situation is exceedingly uncommon, although from the nature of the structures one would expect that this would be an ideal situation for their growth. The following is a description of such a tumour.

The patient, a boy, age 7 years, presented himself complaining of the inconvenience caused by a tumour in the palm of his right hand. It was first noticed twelve months previously, and had gradually increased in size, with more rapid growth during the last three weeks. There was no complaint of pain, nor was it tender to the touch. The

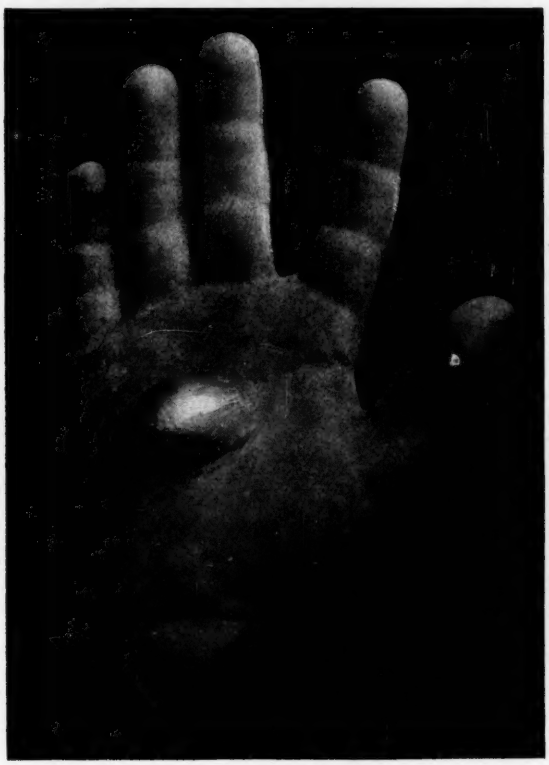


Fig. 291.—Fibroma arising in palm of hand.

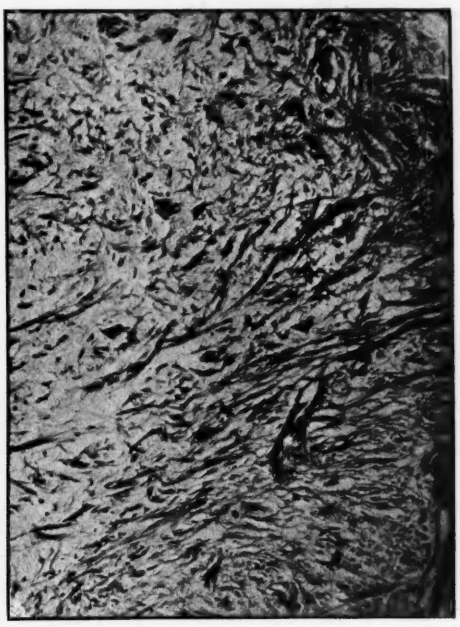


Fig. 292.—Micro-section of same case.

situation was as seen in the accompanying photograph (*Fig.* 291). The tumour was the size of a walnut, firm and elastic, not fixed to the skin or deep structures, nor were the tendons attached to it. *X*-ray examination showed that it had no connection with bone. The boy showed no other physical signs of disease.

The tumour was removed by dissection, extending between the tendons of the ring and middle fingers; it was not in any way attached to them, and its removal was a simple matter.

On section, to the naked eye the cut surface resembled cartilage in colour. Microscopically, the report was "fibroma with areas of myxomatous degeneration" (*Fig.* 292).

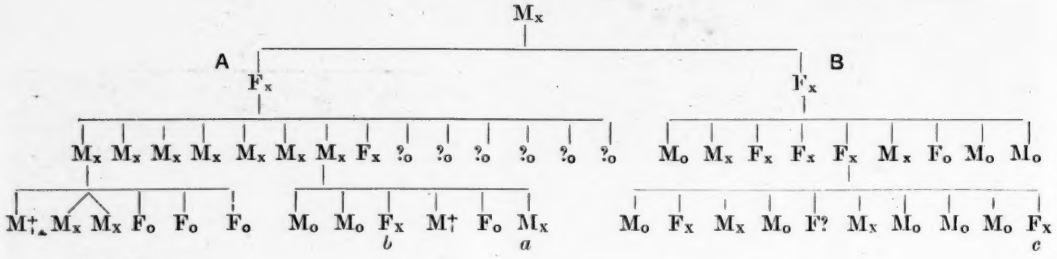
The wound healed per primam, and the boy is reported to be perfectly well.

A CASE OF HEREDITARY POLYDACTYLISM: OCCURRING IN FOUR GENERATIONS AND MANY MEMBERS OF THE SAME FAMILY.

By E. MILES ATKINSON, London.

Cases of polydactylism are not extremely uncommon, and the hereditary tendency of the deformity is well recognized. The interest of this case lies in the fact that it has been possible to trace the occurrence of the deformity back through four generations, and to many members of the family.

GENEALOGICAL TABLE.



M = Male.
F = Female.
o = Condition not present.
x = One additional digit on each hand and foot.
† = One additional digit on each foot only.
a = Patient with condition shown in *Figs.* 293, 294.
b = „ „ „ „ *Figs.* 295, 296.
c = „ „ „ „ *Figs.* 297, 298, 299.

An analysis of the appended genealogical table shows that 48 persons, distributed through four generations, have been traced. Of these, 26, or more than half, have exhibited a condition of polydactylism, 17 being males and 9 females. Males have, therefore, in general, been affected twice as often as females.

But this sex incidence in favour of the males does not hold for both branches of the family. The descendants of one of the two daughters in the second generation—the branch marked A—show a preponderance of polydactylism in the males to the same condition in the females of 11 to 2; while branch B shows a reversed, though much less marked, state of affairs, the condition occurring in 5 females and in only 4 males. In the last generation of this branch, moreover, one female marked ? was a stillborn child, and it is not known if the condition was present or not. Thus, on the one side the deformity has been transmitted from a male, through a female, chiefly to males; on the other in the same way chiefly to females. There seems to be no marked Mendelian feature, nor any common factor, in the nature of its transmission.

As regards the actual deformity present, with two exceptions the same condition occurred in every case—a supernumerary digit, varying in the completeness of its development, upon the posterior border of each hand and foot. The two exceptions are two males, both in branch A, but sons of different fathers, in whom supernumerary digits were present on the feet only. This would seem to indicate that the tendency to inherit the condition is becoming less marked, at any rate among the male members of this branch of the family, so many of whom have been affected.

Anatomical Features of the Deformity.—Although in this family no case has occurred in which there was more than one extra digit on any one limb, cases of as many as eight digits on the hand have been reported,[1] and one case with nine toes has occurred

in America. Two cases of a curious condition of bifurcated hand, in which eight fingers were present and no thumbs, have also been recorded.[2]

According to Tubby,[3] in the usual state of affairs, in which there is only one additional digit, the commonest one to be double is the fifth, the next in order of frequency

FIG. 293.

FIG. 294.

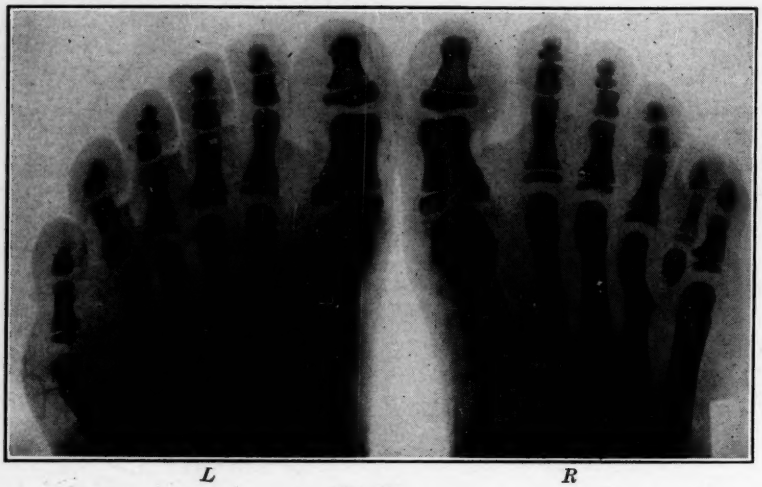
is the first, and rarely any other. The supernumerary digits are said by the same authority to be usually abnormal and ill-developed, and devoid of a metacarpal.

That these last statements are by no means always correct can be seen from the accompanying skiagrams of some of the present cases. In *Figs.* 293 and 295 the additional fingers are very poorly developed and are functionally useless. In *Figs.* 298 and 299 the degree of development is much greater, and, moreover, the fingers in this child could be flexed and extended almost to the same amount as the normal fingers, though abduction and adduction were very limited; while in *Figs.* 294, 296, and 297 the development and function of the additional toes were such that it was very difficult to say clinically which of the two outer toes was the real fifth and which the supernumerary digit. In fact, in the right foot of *Fig.* 296 it was eventually decided that the outermost was the supernumerary toe, the correct decision being only come to after seeing the skiagram. The above remarks hold true for one or two other older members of the family who were seen but who were not skiagraphed.

FIG. 295.

Again, as regards the usual absence of the metacarpal, it will be seen that the whole or part of a metacarpal bone is present in every skiagram with the exception of the first. Even in this case, although when the skiagram was taken there were only two ossific centres present in the rudimentary digit, it is possible that, had the finger been allowed to remain, a similar condition to that seen in *Fig.* 295 would have appeared, in which there are definitely four bones present, one being a rudimentary metacarpal. So that it would seem that at any rate the head, if not the whole, of the metacarpal is usually present, and with this the additional digit articulates. If the head only is present, it may occur as a separate piece of bone as in *Fig.* 296; or the metacarpal bone may serve for two digits, the distal extremity being bifid, as in *Fig.* 297.

Pathology.—The occasional occurrence of additional digits on the hands and feet has formed one of the arguments brought forward by some comparative anatomists against the theory that the pentadactyle manus and pes is the primitive condition in mammals. They would regard these additional digits as evidence of the previous existence of a



L *R*

FIG. 296.

pre-pollex or pre-hallux and of a post-minimus. The work of Howes and Hill on the Dorking Fowl[4] seems to settle the matter conclusively. As a result of their investigations, they conclude that accessory digits are due to fission, and that any increase or decrease of digits from the number five as a normal phenomenon is to be regarded as a specialization.

L *R*

FIG. 297.

A consideration of the *x*-ray appearances tends to confirm this conclusion, that the presence of accessory digits is due to a process of dichotomy which, had it extended further, would have produced an accessory limb, as in the case of J. B. dos Santos (the Human Tripod),[5] or some form of external teratoma. The appearance of the metacarpal

bones in *Figs.* 296, 297, and 298, with their bifid distal extremities, can be more reasonably explained on this theory than on any other. Wood Jones[6] sums up the position in favour of the theory of dichotomy very neatly by pointing out that the fact of babies being occasionally born with two heads "affords no safe ground for believing that our single head has been derived from a primitive condition of polycephaly".

FIG. 298.

FIG. 299.

Treatment.—The treatment of the condition is amputation of the supernumerary digit, and care must be taken to ensure that it is really the supernumerary digit that is being removed. If the true digit is amputated by mistake and the accessory one left, the latter will become distorted and displaced, unless it is unusually well-developed and has a complete metacarpal or metatarsal bone.

In these cases, where accessory fingers were present, they were amputated as being unsightly and practically or absolutely useless. Accessory toes, however, were left, as those patients who also had them stated that they caused no inconvenience beyond the fact that boots a size too large in length had to be worn in order to allow for the increased breadth of the foot.

My thanks are due to Miss Moody Stewart for much trouble taken in collecting the children and their family histories, and to Mr. R. C. Elmslie for permission to publish the case, and for his help and advice.

REFERENCES.

[1] RASCH, *Beitr. z. klin. Chir.*, 1897, Bd. xviii, Heft 2.
[2] MURRAY, *Med. Chir. Trans.*, 1865.
[3] TUBBY, *Deformities*, 1912, i, 104.
[4] HOWES and HILL, "The Pedo-crural Skeleton of the Dorking Fowl", *Jour. Anat. and Physiol.*, xxvi, 395.
[5] BLAND-SUTTON, *Tumours*, 1917, 487.
[6] WOOD JONES, *Principles of Anatomy as seen in the Hand*, 1920, 14.

A CASE OF DOUBLE CONGENITAL DIAPHRAGMATIC HERNIA.

By M. FITZMAURICE-KELLY, Brighton.

A. S., age 35, was admitted to No. 30 General Hospital, Calais, Aug. 9, 1917, with abdominal pain and vomiting. The onset dated from Aug. 6; since then vomiting had been constant, and nothing had been passed per rectum. The temperature had risen to 101° on the evening of Aug 8.

There was a history of two previous attacks of abdominal pain and vomiting since the beginning of the war; these had yielded to treatment. When seen, the patient looked very ill, with an anxious expression. The abdomen was very greatly distended, tympanitic in front and dull in the flanks. Liver dullness abolished. The temperature was 99°, pulse rapid and weak, respiration hurried and thoracic in character.

Operation.—Exploratory laparotomy through a right paramedian incision. The coils of small intestine were enormously distended, and at first the cæcum could not be found. The small intestine was tapped in two places with a trocar and cannula. The cæcum was then found close to the middle line, immediately below the liver, and the ascending colon was found passing through an aperture in the front of the diaphragm behind the seventh right costal cartilage, close to the ensiform cartilage. The gut was strangulated at this point.

The constriction was relieved by dividing the attachment of the diaphragm to the eighth costal cartilage; adhesions within the sac in the thorax were then separated from below and the hernia reduced without great difficulty. The patient's condition precluded any attempt to close the neck of the sac; the latter was stuffed with gauze as a temporary measure, and a Paul's tube tied in the cæcum. The patient continued very ill throughout the next day, and died in the evening of August 10, thirty hours after the operation.

Post-mortem.—The small intestine was greatly distended; but there was no peritonitis. The bowel reduced from the hernia was congested, and was found to consist of large intestine only. The sac, about the size of a fœtal head, lay to the right of the pericardium and in front of the lung and pleura; it was lined with a protrusion of the peritoneum, and did not communicate with the pericardium or pleura.

On the left side was an exactly similar hernia, lying in front of pericardium and pleura, and containing another loop of large intestine. The neck of the sac, being undamaged, was studied on this side. The attachment of the diaphragm to the seventh costal cartilage was absent, and the neck of the sac was thus bounded in front by the seventh costal cartilage, on the inner side by the attachment of the diaphragm to the ensiform cartilage, and on the outer side by its origin from the eighth costal cartilage; behind, an arch of muscular fibres, about three-quarters of an inch in breadth, separated it from the central tendon. The position and relations of the necks of the sacs are shown in the accompanying diagram (*Fig.* 300).

From the sac on the left side the large intestine descended vertically in front of the stomach to the brim of the pelvis, where it passed straight into the rectum. The arrangement of the large intestine, and its relation to the sacs and to the stomach, are indicated in *Fig.* 301.

The liver was remarkable, the right lobe being divided from the left by a deep median groove, and the two lobes being united by a relatively narrow isthmus. This division was due partly to the presence of the necks of the sacs close together in the middle line, and partly to the looping up of the round ligament of the liver by the herniated colon.

The arrangements of the peritoneum were of great interest. The herniæ had a sac derived from the peritoneum, though for the most part obliterated by adhesions. The mesenteries of the colon and colic vessels passed upwards in front of the stomach. The descending colon, passing down in front of the stomach, was attached to it by a short mesentery; below the stomach the mesenteric attachment descended vertically to the brim of the pelvis. The great omentum was undeveloped.

The case recorded above presents several features of interest. The condition was, I think, clearly congenital—witness the arrangement of the colon, which could not be divided into its usual parts, but was almost entirely in the herniæ, and of its peritoneal connections, which showed clearly that it had passed through the hernial apertures before the obliteration of its primitive mesentery. The form of the liver, too, points distinctly to a congenital origin. It is noteworthy that, in spite of this, the patient had reached the age of 35 without severe disability, and had been nearly three years on active service, mostly in the front line.

The sacs are remarkable—indeed, as far as my search through the literature goes, are unique—in two respects. In the first place, I cannot find that any case of double diaphragmatic hernia has been recorded hitherto, and secondly, among the many congenital herniæ which have been published, in no case has the sac been in the same position as that now described. They seem, almost without exception, to have been on the left side in relation to the œsophageal opening, and to have contained the stomach, with or without other abdominal contents. That condition is, indeed, easily explained on embryological grounds; but I have not been able to find anything in published work on

FIG. 300.—1, Neck of sac. 2, Central tendon. 3, Œsophageal opening. 4, Opening for vena cava inferior. 5, Psoas. 6, Quadratus lumborum.

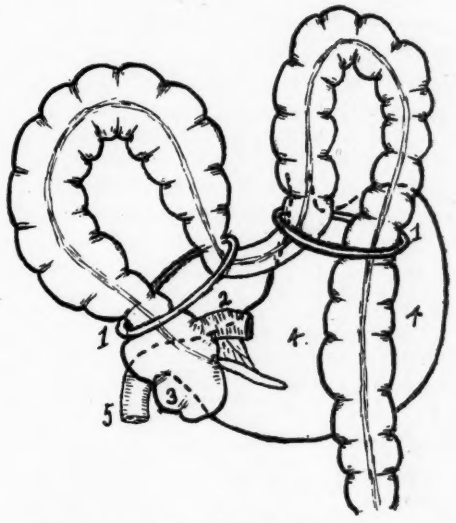


FIG. 301.—1, Neck of sac. 2, Small intestine. 3, Cæcum. 4, Stomach. 5, Duodenum.

the development of the diaphragm to explain the presence of the openings found in this case. And Sir Arthur Keith, to whom I naturally turned in this difficulty, agreed that no explanation was at present forthcoming. At the same time, it is an anatomical fact that a distinct gap is present between the sternal and costal attachments of the diaphragm; and it is possible that further research into its development will throw some light on the genesis of the present case.

As regards treatment, the case now reported was, unfortunately, seen too late to give much chance of recovery, and the question of radical treatment did not arise at operation. But I was impressed at the time with the difficulty—almost the impossibility—of dealing with the sac and the opening from below; and had further operation been feasible, I am convinced that the thoraco-abdominal route would have held out the best prospects of success.

I must express my gratitude to Professor T. R. Elliott for his assistance in recovering the notes of this case from the records.

A CASE OF PERSISTENT VITELLINE DUCT ATTACHED TO THE VERMIFORM APPENDIX.

By P. T. CRYMBLE, Belfast.

The persistence of the full length of the embryonic segment of the vitelline duct, patent and opening at the umbilicus, has been frequently described. Numerous variations of its intestinal attachment have also been recorded, both when it was complete, and when it persisted only as Meckel's diverticulum; so that, according to Kelly,* "the attachment of Meckel's diverticulum to the bowel has been found at all parts between the duodenum and the colon". This case is one in which a persistent vitelline duct was attached to the vermiform appendix, and, as far as has been possible to discover, it is unique in this respect.

A male child, five months old, was brought to the Belfast Hospital for Sick Children for treatment of a projecting mass at the umbilicus. The mother stated that after the cord had separated, a small red projection persisted at the umbilicus, and that this had gradually grown larger in the ensuing months. No fluid or fæcal matter had ever been discharged from the umbilicus, but the surface of the mass had always been somewhat moist. On examination, it was seen that, projecting perpendicularly from the umbilicus, there was a dull-red conical mass about an inch and a quarter in length and having a diameter of about the adult little finger. Its surface was moist and had all the appearances of mucous membrane; and at the margin of the umbilicus this appeared to be continuous with the skin. At the apex of the projection there was an aperture through which a probe could be passed freely into the abdomen.

A skin incision was made round the umbilicus, and carried upwards and downwards for a short distance in the middle line. It was then deepened through the abdominal wall until the peritoneal cavity was opened, when the nature of the projection was at once demonstrated. It was the prolapsed part of a persistent vitelline duct, the proximal extremity of which was attached to the vermiform appendix (*Figs.* 302, 303). The cæcum, which lay in the middle line above the umbilicus, was observed to be of the infantile type. It was freely movable, and there was a mesentery common to it and the ascending colon. The appendix was divided at its base and the vitelline duct thus removed. The child made an uninterrupted recovery.

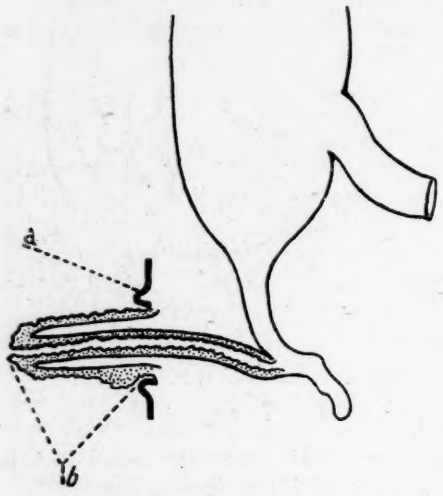


FIG. 302.—Diagram of the relations and connections of the vitelline duct in the present case. *a*, Skin at umbilicus; *b*, Prolapsed part of duct.

The vitelline duct arose from about midway on the length of the appendix and from the surface opposite the attachment of its mesenteriole. It is a little thicker than the appendix. It passes to the umbilicus almost at once, and the greater part of it is prolapsed through that opening. Its total length, when the prolapse was reduced, is $3\frac{1}{4}$ in. Superficial examination shows that the peritoneal and muscular coverings of the duct are continuous with those of the appendix, and that, passing along its proximal part, there is an artery derived from the main stem of the artery to the appendix, and in regard to the nomenclature of which speculation will exist. It sinks beneath the muscular coat about three-quarters of an inch from the appendix.

A transverse section of the duct (*Fig.* 304) shows that in structure it resembles the appendix most of all the parts of the bowel. The glands are more numerous and more

* Kelly, *The Vermiform Appendix*, p. 595. It is probable that many authorities would doubt the classification of the duodenal, and even the colic, diverticula.

convoluted, and the lymphoid tissue is not so abundant as in the adult appendix, but there is the same increase of the submucous layer. The muscular layer is in two uniform coats. The artery, with an accompanying vein, is seen deep to the muscles.

The chief interests of this specimen lie in the peculiar developmental relations implied by its basal attachment, and in the manner in which its peripheral part is related to the tissues of the umbilicus. It seems possible to explain the attachment of the duct to the appendix only on the view that the cæcal diverticulum of the gut occurred at the apex of the primitive intestinal loop, and that the duct remained attached close to the apex of the diverticulum.

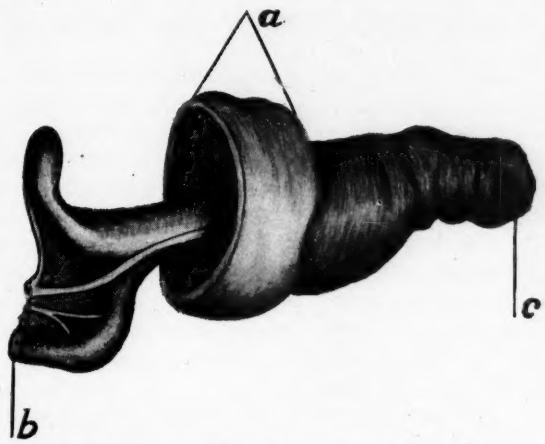


FIG. 303.—The specimen as removed. (*Natural size.*)
a, Umbilicus; *b*, Base of appendix; *c*, Aperture at apex.

A section through the umbilicus (*Fig.* 305) shows very clearly the sharp demarcation between the skin and the mucous membrane of the duct. The prolapsed mucous membrane is seen to be denuded of its epithelium, and to have over its surface a number of small hæmorrhages and what appear to be small necrotic areas. The glands of the prolapsed part also seem to be degenerating. At the actual junction of the skin and the mucous membrane, the blood-supply of the two parts is from a common source—that is, the mucous membrane of the duct might derive its blood-supply from the blood-vessels of the umbilical wall. It has already been pointed out (Stiles) that this factor might account for the persistence of 'mucous grafts' of the vitelline duct or the urachus at the umbilicus, even after there has been a total atrophy of the intra-embryonic segments of those structures.

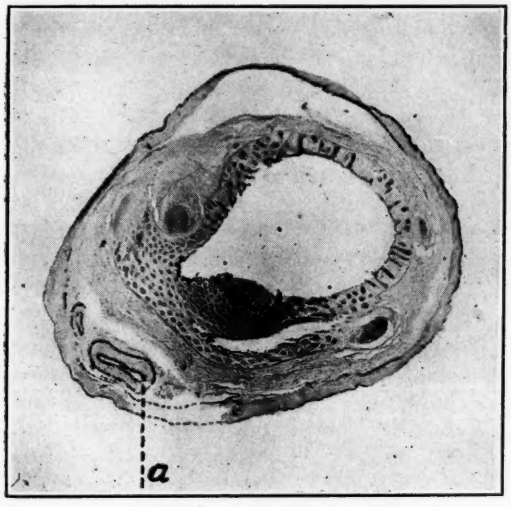


FIG. 304.—Transverse section of the vitelline duct. (× 10.)
a, Artery.

FIG. 305.—Section through the junction of skin and mucous membrane at umbilicus. *a*, Junction of skin and mucous membrane.

The author desires to thank Professor Walmsley for the histological investigation of the specimen and for assistance in the preparation of the paper.

A CASE OF TRIGEMINAL NEURALGIA IN A BOY, AGE 10 YEARS, TREATED BY INTRACRANIAL DIVISION OF THE SECOND AND THIRD DIVISIONS OF THE NERVE.

By J. HAMILTON BARCLAY, Newcastle-on-Tyne.

This case justifies its publication on account of the extreme youth of the patient.

History.—A. K., age 11 years, was admitted to the Hospital for Sick Children, Newcastle-on-Tyne, Oct. 8, 1918, with severe attacks of pain and twitching of the facial muscles on the right side of the face.

The boy had received a blow on the right side of the face about two and a half years previously. The symptoms came on about a year after the accident, and occurred on an average every hour for about two days per week. *X*-ray examination revealed nothing abnormal; the teeth had previously been attended to, and several had been removed. He was treated by sedatives and general hygienic measures, and was much improved when he left hospital on Oct. 26.

The pain returned and became very severe, and he was re-admitted on Dec. 17.

Fig. 306.—Showing operation scars in right temporal and infra-orbital regions.

The following are the notes of his condition at that time: "He now suffers from spasmodic attacks of severe pain; talking excites an attack, radiating over the right side of the face. There is an erythematous rash on the right side. Percussion of the inferior dental, superior maxillary (?), supra-trochlear, or supra-orbital nerves does not excite a spasm. He averages three attacks every two hours. He is a healthy-looking child, and has had no serious illness before. No atrophy or paralysis of the facial muscles".

On Dec. 21, 1918, he was operated on by one of my predecessors. Under chloroform anæsthesia a trocar and cannula was inserted below the right zygoma, and absolute alcohol injected into the second division. Œdema of both lids of the right eye was noticed, and hæmatomata developed in these eyelids while recovering from the anæsthetic, during which time there was twitching of the facial muscles. The hæmatomata gradually disappeared and the attacks became fewer and less severe, completely disappearing in three weeks. Discharge, Jan. 17, 1919.

Two months later, attacks returned, and the boy was re-admitted for the third time, The day following he was operated on. A transverse incision was made below the right orbit, the terminal branches of the infra-orbital nerve were divided, and alcohol injected into the canal. The pain was relieved, and he went home May 13.

After six months freedom from pain, the spasms returned with a severity which necessitated his admission to hospital for the fourth time, on Feb. 4, 1920, under the care of the writer.

The Condition at that time was as follows: He was having excruciating 'epileptiform' attacks of pain on the right side of the face, accompanied by twitching of the right facial muscles, every two or three minutes (typical 'tic douloureux'). During a preliminary

examination, lasting about ten minutes, he had four severe spasmodic attacks of pain; these chiefly involved the second division of the fifth cranial nerve (mostly infra-orbital branch), but also to a less extent the third division of the nerve (mostly inferior dental branch). The first or ophthalmic division was not affected. During the attacks the boy screwed his face up, and pushed his hand hard on to his face. His mother stated that when the pain came on at first he moaned and groaned, but later it became so severe that he screamed out and frequently disturbed the neighbours. During the two days he was in hospital before the operation he had no sleep. Ordinary sedatives were useless. During the spasms there was flushing of the right side of the face, and also some increased lachrymation and salivation. Eating or speaking, or any excitement, provoked attacks. Pressure on the angle between the right ala nasi and the cheek also brought on a spasm—the mother stated that he had to be very careful in washing his face, and that he would not allow her to do it. Sitting in front of a fire also excited the spasms.

There was no apparent local cause for the trouble. *X*-ray examination was negative, and there was nothing abnormal in the eyes, nose, or ears. Every effort was made to exclude the presence of a cerebral tumour. The general condition was very poor owing to the pain and loss of sleep and food.

As it was obvious the boy could not go on as he was, a more radical operation was decided upon.

Operation, Feb. 6, 1920.—Under general anæsthesia (A.C.E. and ether) a semicircular incision, convex upwards, was made, extending from a point immediately above and in front of the right pinna posteriorly to a point a short distance above and behind the external angular process of the right frontal bone. The convexity was about 1½ to 2 in. above the base of the flap. All the structures were divided down to the bone, and the soft parts peeled down towards the zygoma, which was not interfered with. A ½-in. trephine opening was then made above the middle of the zygoma, and this was enlarged by rongeur forceps, especially downwards towards the infratemporal crest, till the opening was approximately 1½ in. in diameter. Owing to the age of the patient and his poor general condition, it was not thought advisable to prolong the operation by turning down an osteoplastic flap. The dura mater was then separated from the floor of the middle fossa (partly by blunt-pointed, curved scissors and partly by gauze dissection), and kept out of the way by a flat retractor. The second division of the trigeminal nerve was soon distinctly seen running as a whitish cord from the dura mater to the foramen rotundum (it was anticipated that the third division of the nerve would have been encountered first). The second division was not divided at this stage. The trunk of the middle meningeal artery was then seen emerging from the foramen spinosum, and kept constantly in view without dividing it. Immediately anterior and internal to this, the third division of the nerve now came into view after further separating the dura. Considerable difficulty was met with in separating the dura from the edges of the foramen ovale—this difficulty was increased by an unduly large prominence on the floor of the middle fossa immediately external to the opening. In order to effect the separation more easily and secure more room, the second division was seized with forceps, and a third to a half inch of the trunk excised. The dura was well separated from the margins of the foramen ovale, and the third division cut across—there was not sufficient of the trunk between its origin from the Gasserian ganglion and the foramen ovale to excise a portion. A probe, bent towards the point at a right angle, was pushed into the foramen ovale and foramen rotundum to make sure that these openings were empty, and their margins could now be seen all round. A fair amount of hæmorrhage occurred on dividing the third division, presumably from the small, or accessory, meningeal artery coming up through the foramen ovale. A piece of temporal fascia was implanted over each opening, and the brain was allowed to expand. The wound was sutured—the temporal fascia and muscle with catgut, and the skin with silkworm gut. A small drainage tube was left in the posterior angle of the incision for twenty-four hours. The operation lasted about an hour and a half—a large part of this time was spent in separating the dura from the margins of the foramen ovale. The patient stood the operation well, during which there was very little

hæmorrhage; there was remarkably little on separating the dura from the middle fossa; the only bleeding of any moment was on cutting across the third division, but this was soon controlled by gauze pressure and allowing the brain to expand by removal of the retractor. The middle meningeal artery was not interfered with. There was no escape of cerebrospinal fluid, except a slight amount on cutting the third division.

Condition after Operation.—The boy made a good recovery, and went home on March 28. It was noticed after the operation that the pupil was contracted and the palpebral fissure narrowed on the right side (*Fig.* 306). This was probably due to some injury to the cavernous plexus of the sympathetic, fibres from which supply Müller's muscle in the eyelids and the dilator pupillæ in the iris. It was also noted that the boy could not wrinkle his forehead on the right side, due to the branch from the facial nerve to the corrugator supercilii muscle being divided in the anterior part of the scalp wound.

The operation immediately produced the desired results—the pains ceased, and there was anæsthesia over the cutaneous and mucous surfaces supplied by the second and third divisions of the trigeminal nerve, including ordinary sensation of the right half of the tongue in its anterior portion. Taste was little, if at all, affected, the taste fibres of the third division joining the lingual nerve outside the skull, via the chorda tympani nerve. There was also paralysis of the muscles supplied by the motor portion of the third division, i.e., the muscles of mastication. This was only slightly noticeable, the muscles on the other side apparently being able to carry on the function satisfactorily. When the boy opened his mouth there was slight deviation of the mandible towards the right side. He chewed with the left side of the jaw, and food was apt to collect on the right side. There was also a tendency for saliva to dribble out of the right angle of the mouth. There was no facial paralysis other than that of the right corrugator supercilii above mentioned.

Present Condition, July, 1921.—He is now in the best of health (17 months after operation). He has put on weight, is sleeping and eating well, and has had no recurrence whatever of the pain. There are no signs of the trouble spreading to the ophthalmic division of the nerve.

A CASE OF ABDOMINOTHORACIC TETANUS (MARIE).

By S. T. IRWIN, Belfast.

The patient was a farmer, age 50, whom I saw in consultation on March 2, 1920.

History.—The man was seized with a sudden attack of pain in the left side of the abdomen on February 28. He was put to bed and poulticed, and given a dose of castor oil. Next day, as the pain had not abated, he was seen by a doctor, who found the temperature 101°, pulse normal, and some rigidity of the upper abdomen. On the third day there was no alteration in the man's condition, and a surgeon was called in. The latter thought there might be an abdominal lesion and advised an exploratory laparotomy. The man was therefore removed to a cottage hospital, where the abdomen was opened through an upper left rectus incision on Monday, March 1. An extensive search was made of the whole abdominal cavity without finding any lesion sufficient to account for the symptoms. On recovering from the anæsthetic the symptoms began again, and the pain was so severe that repeated hypodermic injections of morphia were required. Even these did not relieve the severity of the spasms.

Next day I was asked to see the patient, and examined him the same evening, twenty-four hours after the laparotomy. In addition to the history already given, I learnt that twenty years ago he had suffered from bone disease of the left thigh and knee, and that the latter was stiff. There was a small sinus from which a discharge now and then escaped, the last time being about a month previously. I also learnt that he had had an attack of pain in the *right* side of the abdomen a fortnight ago, which had disappeared with poulticing and a dose of castor oil. As regards the present affection, he had been vomiting

during the whole twenty-four hours succeeding the operation; he had passed no flatus per rectum, but his bowels had acted well after the aperient which he had had on the first day of the attack. He said the pain was continuous, but at times he got such a severe 'cramp' that it made him cry out.

Examination.—The man was healthy-looking and well coloured. Every few minutes he vomited a small quantity of bile-stained fluid. Temperature 99·2°; pulse 68; respirations 24. Tongue moist and moderately clean; the heart was normal. Chest moved normally, with the exception of the lower part of the left side, where there was obvious rigidity, replaced now and then by severe contractions. There was no dullness, and no friction sounds or crepitations were to be heard anywhere. The abdomen was generally distended, but not fixed. Respiratory movements were present, but were better marked on the right side. Both sides of the hypogastrium were soft. There was a healthy-looking wound through the left rectus, closed by sutures. There was no localized swelling, and no localized tenderness could be elicited.

The *left costal margin* demands special description. The patient centred his pain around the tip of the 10th costal cartilage. On pressure a rough crepitus could be felt, and on auscultation could be heard, over this cartilage. The tip of the cartilage was loose and could be rubbed on the rib above. At times this seemed to produce severe pain and spasm of the neighbouring muscles—left rectus, oblique muscles, and, apparently, lower intercostals.

The *left knee* was ankylosed. There was a depressed discharging sinus just above the left knee-cap. The discharge had begun about four weeks previously. Rectal examination was negative. Urine 1022; acid; contained a trace of albumin; no sugar; loaded with urates.

Differential Diagnosis.—1. Could it be a chest condition? A basal pneumonia, or a diaphragmatic pleurisy? This was excluded because, seventy-two hours after the onset of the pain, there were no definite signs, the respirations were only 24, and the pulse-rate was 68.

2. Could it be an abdominal condition—especially a small perforation into the lesser sac? This was excluded because an extensive exploration at operation had revealed nothing; the pulse seventy-two hours after the onset of the symptoms was still 68; there was no pain in the left shoulder; abdominal movements were still present, and respirations were not laboured.

3. Was the lesion in the abdominal wall a neuroma, or the nipping of an intercostal nerve by a fractured costal cartilage? Against the latter was the absence of injury, and although there was evidently a separation of the costal cartilage, movement of it did not always produce the severe pain.

4. Eventually I came to the conclusion that none of the foregoing theories accounted for the symptoms, and decided that we were dealing with a case of localized tetanus, and that during a spasm the 10th costal cartilage had been separated from the rib above. The patient was therefore immediately given all the available antitoxin.

That the diagnosis was correct was proved by subsequent evidence: (1) In spite of treatment the spasms spread and ultimately involved the jaw to a slight degree. (2) The *Bacillus tetani* was isolated and grown by Dr. J. L. Rentoul from a smear of the pus from the sinus. (3) Under treatment by 6000 units of antitoxin daily the spasms diminished in their frequency, but their intensity remained unabated for about ten days, so that on three occasions the patient burst the abdominal sutures and almost eviscerated himself. After the third of these he developed a low form of peritonitis with hiccough and vomiting, which became fæcal, and he died on the twenty-fourth day after the laparotomy. Had it not been for the abdominal wound, recovery would, I think, have taken place, as no spasms had occurred after the fourteenth day.

This appears to me to be an example of abdominothoracic tetanus of the type described by P. L. Marie, and quoted by Bruce and Golla in their book *Abnormal Forms of Tetanus*.

TORSION OF THE GALL-BLADDER.

By S. T. IRWIN, Belfast.

The rarity of this condition, judging by references to it in literature, leads me to report the following case.

On March 21 I was asked to see a case of 'acute abdomen' at the Royal Victoria Hospital, Belfast. The patient was a woman, age 34, married, with one child 6 months old. Twenty-six hours before admission she was suddenly seized with an acute attack of epigastric pain. The pain was very severe, requiring a hypodermic injection of morphia. She vomited frequently throughout the night, but this did not relieve the pain. Vomiting had ceased before she came into hospital. The bowels had acted three times after the onset of the pain.

On Admission, she complained of severe pain in the epigastric region, rather to the right side, which went through to the back but not upwards nor into the right shoulder. She had not vomited for some hours, and an enema had been returned without fæcal result.

On Examination, her temperature was 99°, pulse 90, and respirations 24. She was not jaundiced; her abdomen was not distended; there was no visible peristalsis; the Newcastle sign of perforation was absent; respiration was not confined to the thorax. The abdomen was generally rigid, but rigidity was most marked above the umbilicus. There was great tenderness over the gall-bladder, especially on deep pressure, but there was also localized tenderness at McBurney's point. Hyperæsthesia (Ligat) was most marked at the appendix point. There was no phlegmon to be felt, either in the gall-bladder or appendix region. Rectal examination was negative.

Previous History.—There was a history of attacks of 'biliousness' since girlhood, and a constant condition of bronchial catarrh, which could be heard without the use of the stethoscope. Immediately after her confinement, six months previously, she had a pain similar to the present one, but less severe. This pain persisted in a modified form during the whole lying-in period, but there had been a clear interval between then and the onset of the attack under review.

Diagnosis.—This seemed to lie between a gall-stone blocking the cystic duct and an acute appendicitis. The former view seemed the more likely, for the pain after twenty-six hours was still in the epigastrium, there was marked tenderness on deep pressure over the gall-bladder, and the rigidity was most marked in the upper abdomen. The doubt in the case arose from the well-defined area of hyperæsthesia in the appendix region, which suggested an appendicitis complicated by non-descent of the cæcum.

Operation.—Owing to the bronchitis, we decided to explore the upper abdomen under local anæsthesia (2 per cent novocain), having previously given a hypodermic injection of $\frac{1}{4}$ gr. morphia and $\frac{1}{150}$ gr. atropine. This revealed a gangrenous gall-bladder, tense, black in colour, about the size of a small hen's egg. Further investigation under ether anæsthesia proved the condition to have arisen from a torsion of the gall-bladder, which had been twisted clockwise through one complete revolution (360°). The twist was situated in the proximal part of the gall-bladder itself, and did not include the spiral valve. There was complete strangulation of the blood-vessels, and the contents were chiefly blood, mixed with a trace of bile. Cholecystectomy was, therefore, performed, and the subsequent history of the case has been uneventful.

Volvulus, or torsion, of the gall-bladder is referred to in the *Medical Annual* of 1913. Moynihan and Upcott quote Kubig, who, in 1912, met with a case post mortem, examined the literature, and found records of three other cases, all in persons of somewhat advanced age. Turner and Rowlands refer to the same cases. Hansen records the disease in a woman of 79 in whom the gall-bladder was hourglass-shaped. The literature, so far as one can trace, comprises seven previous cases, in which the main points are: (1) Advanced age of the patient, the present one being an exception. (2) The absence of gall-stones,

which were found in only one case. (3) The difficulty in accurate diagnosis—apparently not one of the cases was diagnosed before operation. (4) The success following laparotomy in all the cases in which this was undertaken.

A list of the references, for which I am indebted to Mr. H. E. Powell, Librarian, Royal Society of Medicine, is appended.

BIBLIOGRAPHY.

KUBIG, G., " Ueber Volvulus der Gallenblase ", *Münch. med. Woch.*, 1912, lix, 1938.
MÜHSAM, R., " Stieldrehung der Gallenblase ", *Berl. klin. Woch.*, 1908, xlv, 1179.
MAYER, W., " Ein weiterer Fall von Stieltorsion der Gallenblase ", *Ibid.*, 1602.
FISCHER, A., " Ein weiterer Fall von Stieltorsion der Gallenblase ", *Ibid.*, 1910, xlvii, 1784.
WENDEL, A. V., " Case of Floating Gall-bladder and Kidney, complicated by Cholelithiasis with Perforation of Gall-bladder and Extreme Torsion of Duct ", *Ann. of Surg.*, 1898, xxvii, 199.
NEHRKORN, " Gangrän der Gallenblase durch Stieldrehung ", *Deut. Zeits. f. Chir.*, 1908, xcvi, 319.
HANSEN, *Hospitalstidende*, 1921, March 30.

OCCIPITAL ENCEPHALOCELE CONTAINING A PROLONGATION FROM A LATERAL CEREBRAL VENTRICLE.

BY W. G. SPENCER, LONDON.

IN the following case the mother of the child said that she had applied to two other London hospitals, at both of which she had been advised against operative treatment. Doubtless the view that operative treatment is contra-indicated accords with the prevailing

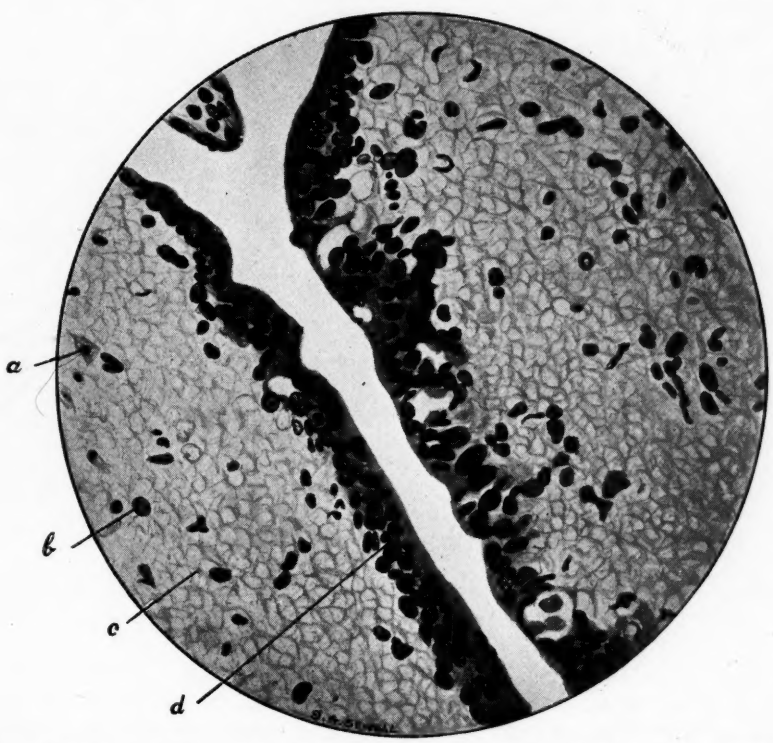


FIG. 307.—Transverse section through base of pedicle. (× 220.) *a*, Neuroblast; *b*, Round cells infiltrating; *c*, Myelospongium; *d*, Ependymal cells.

statements in books and with most of the specimens in museums. The encephalocele is generally a protrusion of the cerebellum and 4th ventricle; other deformities, such as

hydrocephalus internus and spina bifida, co-exist. Museum specimens of still-born fœtuses present marked arrests of development, both of the brain and skull, along with the protrusion below the tentorium. This child, on the other hand, showed no signs of any other deformity. I had operated on a similar case some years before, and had kept the little boy under observation for two years. A similar success has followed excision in the present instance.

The patient, a male, age 1 year 5 months, was admitted to the Westminster Hospital with a swelling having the typical signs of an occipital encephalocele. It had been present

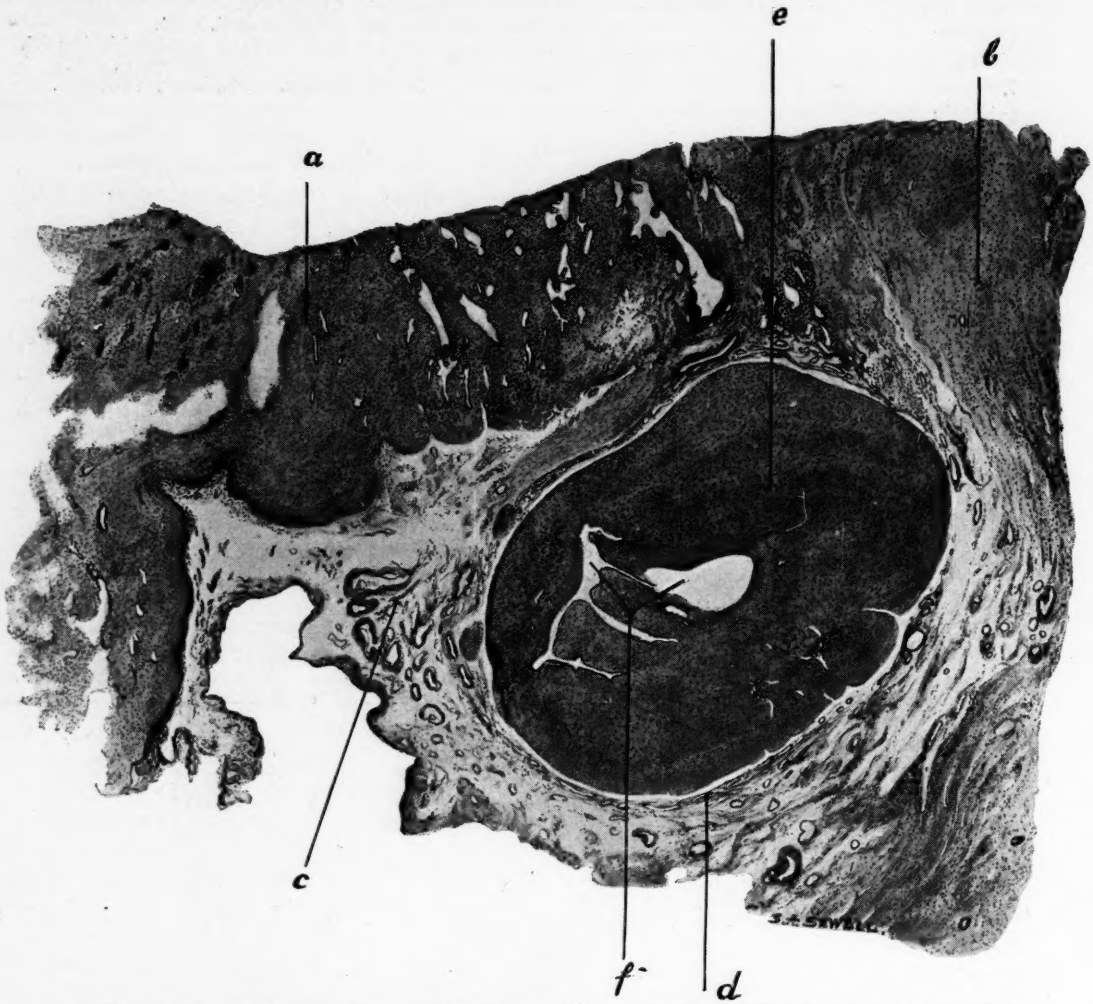


FIG. 308.—Transverse section through base of pedicle. (× 8.) *a*, Tissue derived from pericranium and dura mater; *b*, Fibrocellular tissue, probably inflammatory in origin; *c*, *d*, Arachnoid and pia mater; *e*, Cerebral wall; *f*, Extension of ventricle.

from birth, and at times had swelled up to the size of a hen's egg; at times, when the child was unwell, it had become much smaller. The child could neither walk nor talk; it had only one tooth, a lower central incisor. It had been subject to recurring slight attacks, presumably of meningitis, with temporary increase of intracranial tension. The child could hold the head upright, but tended to keep it retracted. There was a scab on the superficial pole of the swelling, due to rubbing on the pillow. The pedicle was too thick for the outline of the gap in the skull to be felt. *X*-ray examination showed a small hole between the cartilaginous and membranous portions of the occipital bone. An incision

was made round the base of the swelling down to the bone, and the attachments of the pedicle to the margin of the foramen were separated by a raspatory. This enabled the pedicle to be drawn out a little, so that when a ligature was applied and the encephalocele beyond the ligature cut away, the stump sank back within the cranium. Whilst traction was being made on the pedicle, the child stopped breathing; but breathing recommenced when the ligatured stump of the pedicle receded. The foramen was circular, about 1 cm. in diameter; it was filled by turning in muscle from the occipitalis, over which the occipitalis and skin were separately sutured.

The child recovered without complications, and was examined one year and five months after the operation, being then two years and ten months old. He was a bright little boy, who walked beside his mother, talked well, and had all his teeth. Whilst the mother was describing the progress the child had made, the boy ran about and tried to clamber upon a form. There was a slight internal squint of the left eye, which had been only noticed since the operation. The scar was quite sound, and no gap in the skull and no impulse could be felt.

The sac removed was covered by normal scalp, underneath which, towards its superficial pole, there was a thin fibrous layer with a smooth lining. Towards the pedicle the various layers were distinguishable—the occipitalis with blood-vessels, the pericranium, the dura mater and arachnoid, and brain-matter around a cavity.

Sir Arthur Keith has examined the section of the pedicle close to the level of division, and supervised Mr. Sewell's drawings (*Figs.* 307, 308). He thinks that the specimen shows cerebral brain-matter and not cerebellar tissue.

He has, moreover, re-examined a specimen in the Royal College of Surgeons' Museum, and has supplied the following description:—

Teratological Series, 340.2.

Occipital encephalocele in a stillborn full-time child. A dissection on the lateral aspect of the specimen shows that the protrusion has escaped at the upper part of the foramen magnum, while the mesial sagittal section shows that it is made up of folded parts of the occipital lobe which have overridden and compressed the cerebellum—indicated by an arrow.

REVIEWS AND NOTICES OF BOOKS.

The Spleen and Some of its Diseases: Being the Bradshaw Lecture of the R.C.S. of England, 1920. By Sir Berkeley Moynihan, K.C.M.G., C.B. Royal 8vo. Pp. x + 129, with 13 full-page diagrams. 1921. Bristol: John Wright & Sons Ltd. 21s. net.

There have been numerous works devoted to the spleen; in the rather remote past they dealt mainly with speculations as to its function, and as late as 1876, Patrick Black, physician to St. Bartholomew's Hospital, brought out a curious "Essay on the Use of the Spleen, with an Episode of the Spleen's Marriage—a Physiological Love Story"; but coming down to the early years of the present century, the late Sir Frederick Taylor delivered the Lumleian Lectures at the Royal College of Physicians of London for 1904 on "Some Disorders of the Spleen", supplemented in the following year by his inaugural address to the Midland Medical Society on "The Spleen and its Sufferings", in which he prophetically and rather pathetically remarked that the wonderful advances of surgery made it easier for a surgeon than for a physician to bring forward novel, interesting, and important material. In 1917 a valuable contribution on "The Spleen and Anæmia", by R. M. Pearce, Professor of Research Medicine, E. B. Krumbhaar, Assistant Professor of Research Medicine, and C. H. Frazier, Professor of Clinical Surgery, all of the University of Pennsylvania, struck a fresh note in a piece of team work on this organ, in which a surgeon took his place.

Now, with the publication of Sir Berkeley Moynihan's fine monograph, which contains the material collected for the 1920 Bradshaw Lecture of the Royal College of Surgeons of England, a surgeon has boldly and successfully stepped into the field where previously physicians held sway. As is well known, Sir Berkeley wrote on the surgery of the spleen in W. W. Keen's *Surgery*, but he now presents a much wider review of its diseases, and this course is fully justified, not only by the comparatively recent extension of surgical treatment to conditions such as hæmolytic jaundice and pernicious anæmia, but by the need for experienced criticism of the indications for splenectomy. Thus, in the description of polycythæmia vera or Vaquez-Osler syndrome, a warning is thrown out that, as the spleen tends to keep the plethora within the limits compatible with life, splenectomy should not be performed; again, in regard to the rare cases in which the spleen appears clinically to be the only site of lymphadenoma, it is stated to be very doubtful if its removal has any effect, good or evil, on the progress of this disease.

This well-got-up volume contains thirteen chapters dealing respectively with the anatomy, surgery, and functions of the spleen, the pathology of splenic diseases, the clinical and associated phenomena in splenic disease, pernicious anæmia, leukæmia, Hodgkin's disease, splenic anæmia and Banti's disease, hæmolytic jaundice, Gaucher's disease, von Jaksch's disease and polycythæmia, the differential diagnosis condensed into a table adapted from Krumbhaar, and an interesting discussion on the liver in some of its relations to the spleen. Emphasis is rightly laid on the importance of recognizing that abnormal conditions of the spleen are not necessarily confined to that organ, but may cause or be the result of pathological changes elsewhere in the body.

The relations between the spleen and other parts of the body, especially the liver and the bone-marrow, are illustrated by eight full-page diagrams, for which and for help in other ways the author expresses his indebtedness to Dr. O. C. Gruner, his assistant in his private laboratory.

The history of splenectomy in leukæmia, which until quite recently was widely condemned, is sketched, and here, as in other chapters, the most recent results from the Mayo Clinic (up to September 20, 1920) are quoted; thus in 26 cases of leukæmia submitted to splenectomy there was one immediate fatality, or 4 per cent, but this mortality, so markedly different from that when the large size of the organ was a chief reason for its removal, depends on the previous reduction of the size of the spleen by means of radium. In the account of splenic anæmia the view is taken that the anæmia is not necessarily traumatic but may be toxic, and also that the same explanation holds good as to the causation of the gastro-intestinal hæmorrhages; this remarkably comprehensive description is made even more complete by the figures from the Mayo Clinic, namely, 73 splenectomies with 9 deaths, or a mortality of 12 per cent.

The diagram illustrating the chief changes in hæmolytic jaundice represents "extensive hepatic fibrosis," and in the text the occasional existence of biliary cirrhosis at the necropsy is mentioned; in the discussion on the liver in some of its relations to the spleen it is stated that in hæmolytic jaundice the liver is as greatly enlarged as it is in biliary or hypertrophy cirrhosis; these views are not in accord with general experience, and might therefore perhaps be further elaborated or modified in the second edition that is certain to be required.

The chapter on pernicious anæmia contains a personal communication from Dr. N. M. Percy, of Chicago—whose experience of the surgical treatment of the disease is described as unsurpassed—on the diagnostic features that he considers of great importance, namely, absence of hydrochloric acid from the gastric juice, the glossy smooth tongue, cutaneous pigmentation, chronic nephritis, intermittent diarrhœa and vomiting, and nervous manifestations; it is noteworthy that in 95 per cent of his cases there was evidence of focal infection, and that among 33 cases operated upon and investigated the gall-bladder was infected in 24. The question of splenectomy is discussed in an open-minded manner, and no claim for cure is suggested, though half the patients operated upon are improved.

In conclusion, this attractively written monograph, which contains interesting historical data with a broad survey of our most recent knowledge, not only presents the results of wide personal experience and thought, but provides both surgeons and physicians with many suggestive ideas.

Genito-urinary Surgery and Venereal Diseases. By EDWARD MARTIN, A.M., M.D., F.A.C.S., BENJAMIN A. THOMAS, A.M., M.D., F.A.C.S., and STIRLING W. MOORHEAD, M.D. Demy 8vo. Twelfth edition, revised. With 424 engravings and 21 coloured plates. 1920. Philadelphia and London: J. B. Lippincott Company. 35s. net.

THE success of this rather monumental text-book (901 pages: weight 4½ lb.) is attested by its having reached its twelfth edition; the book is so well known to English surgeons that only a few remarks on this new edition will be necessary.

Though well bound and clearly printed, the work is heavy and bulky, and difficult to read with any comfort; we think it would have been more convenient if it had been issued in three volumes. The illustrations are quite up to the average and have been carefully chosen, but some of the microphotographs are so poorly reproduced that they convey little information to the reader and might well be omitted.

In this work will be found an enormous mass of facts described with clearness and accuracy. The searcher after new facts and theories will not find much to interest him, nor must he look therein for any startling deviations from the accepted methods of treatment. We would even go so far as to suggest that the authors' opinions on some questions of genito-urinary surgery need revision.

On page 10, in the discussion of the treatment of "the bleeding of prostatics", the authors recommend "the evacuation of the blood by means of a catheter and syringe and keeping the bladder empty by the retained catheter; if the clots cannot be removed in this way, perineal or suprapubic cystotomy is indicated; if bleeding persists, pressure over the pubis, applied by means of compresses, must be tried". We consider the last-mentioned method extremely ineffectual; surely the removal of the prostate is the best and simplest way to stop prostatic bleeding! We have done this on several occasions and have found it quite efficient; if, for any reason, it were thought unwise to do a prostatectomy, we should open the bladder suprapubically and apply a gauze packing to the bleeding surface.

A surprising omission is to be found under the heading of the treatment of pyelitis (pp. 635–6): no mention is made of the administration of alkalis.

In the article on nephroptosis (p. 592), we find the same list of causes as was set out in our student days; tight lacing seems to have kept its place in the authors' esteem as a cause of movable kidney; yet it is fourteen years ago that we read of Trekaki's observations on Arab women, amongst whom corsets are not *à la mode*; he states that they show a higher percentage of cases of movable kidney than European women. It is true that the authors mention the weight of the hollow viscera as one of the causes, but there is no reference to the work of Sir Arbuthnot Lane on stasis and his theory of the pull of the displaced ascending colon on the kidney, nor is Waugh's recent paper mentioned.

If, as we think, these are defects in the work, yet they are such as may easily be remedied, and we hasten to add that the book is a valuable work of reference and a tribute to the knowledge and industry of the authors.

Surgical Anatomy of the Temporal Bone. Collection of Lantern Slides, demonstrating the Surgical Anatomy of the Temporal Bone, with Photographs, Catalogue, and Guide. By ARTHUR CHEATLE, F.R.C.S. Set of 200 slides in 5 boxes, with album of 200 photographs and catalogue. 1921. London: H. K. Lewis & Co. Ltd. £30.

SOME thirty years ago Mr. Arthur Cheatle began to collect temporal bones of known age and sex in order to study the changes which come about from growth and age, the anatomical variations which are most commonly met with, the prevailing types of structure, the degree to which the bone of one side is likely to differ from that of the other side, and the changes wrought by disease—all being points of importance to surgeons operating on the ear. In the course of twenty years Mr. Cheatle's collection became the most complete and important representation of its kind in the world. In order that other surgeons might share in the fruits of his labour, Mr. Cheatle, with great generosity, presented his entire collection to the Museum of the Royal College of Surgeons, where

it is now available for study by all. He not only presented the collection, but prepared and had published a descriptive catalogue-guide to it for the use of visitors.

Surgeons who attended the Ninth International Otological Congress, held in Boston in 1912, will remember the report which Mr. Cheatle communicated on the "Examination of both Temporal Bones from 120 individuals in reference to the question of Symmetry in Health and Disease". Since then he has enriched the collection by many further additions. On this occasion many surgeons expressed a regret that a collection which had cost so much time, trouble, and expense to bring together, could not be made available for use in aural cliniques of all lands. In answer to this feeling, Mr. Cheatle has made his collection available for teaching purposes by having 200 lantern slides prepared from specimens in his collection—all of them excellent examples of the photographer's art. The slides, with catalogue and guide, can be had for £18, while an album of photographs, in place of the slides, with catalogue and guide, costs £14. The price seems high, but is not more than covers the materials and labour involved. Mr. Cheatle deserves the thanks of the medical profession for placing the labour of years so fully at its disposal.

Diathermy: its Production and Uses in Medicine and Surgery. By ELKIN P. CUMBERBATCH, M.A. Oxon, M.R.C.P., Medical Officer-in-Charge, Electrical Department, St. Bartholomew's Hospital. 8vo. Pp. 193 + x. 1921. London: William Heinemann. 21s. net.

DIATHERMY is a comparatively new method of treating disease. As the term implies, it is a 'through heating', in which an electric current of a special kind, generated by a special machine, traverses the body. The tissues are, therefore, heated *throughout*.

The book opens with an historical note dealing with the work of Tesler and D'Arsonval, following a discussion of Nagelschmidt's method, who was really the first to introduce and popularize the new treatment in this country. Various forms of the apparatus are described in detail, and careful illustrations are given, showing the method by which the sparks are obtained.

Chapter 5 deals with the physiological effects of diathermy, and it is pointed out that there is a very definite reaction on the part of the tissues to the current. Alterations in the blood-pressure are noticed; in one instance there was a fall of 10 mm. in the systolic blood-pressure, while other charts illustrate the fact that there is a definite increase in the temperature. Generally speaking, as the result of the experiments described in Chapter 6, there is an elevation of temperature, varying from 2° to 9°.

Chapter 7 deals with medical diathermy, in which the therapeutic effects of heat are distributed generally, either to the body as a whole, or to the part affected. Careful details are supplied as to the method of application of electrodes, and indications as to the strength of the current required for various conditions.

Sections III, IV, and V of this chapter deal with some of the medical conditions for which diathermy has been used with considerable benefit, and they include circulatory disturbances, neuritis, sciatica, arteriosclerosis, paralysis agitans, and gonorrhœal infections.

Chapter 8 considers the use of diathermy in surgery, and opens with an illustration indicating the amount of destruction caused when the active electrode is placed in contact with the tissues. In diathermy the electrode is cold when it is placed on or in the tissues, and remains cold until the current passes to it from the negative electrode. Anyone who has seen the cauterizing effect of this diathermy in surgical conditions must be astonished at the wide area of destruction created. Illustrations of the different forms of electrodes for use are figured, and details are given as to their methods of application.

In Section IV, the treatment of cases by diathermy is described, and the attention of the reader is directed to the danger of using this process of cauterization in the neighbourhood of large arterial channels, which must always be ligatured as a preliminary; otherwise dangerous, even fatal, secondary hæmorrhage may supervene.

In Section V, particulars of some cases treated are given: growths of the mouth and throat, palate, and tonsil, inoperable carcinoma of the breast, rodent ulcer, warts, and papillomata of the bladder. It is in connection with this latter affection that diathermy finds one of its greatest uses in surgery.

The book is well printed, the illustrations are clear, there is an efficient index, and the author is modest in his claims on behalf of what is, at present, an experimental method of treatment. The method, however, will undoubtedly fill an important place in the therapeutics of both medicine and surgery.

The American Year-Book of Anæsthesia and Analgesia. Edited by F. H. MCMECHAN, A.M., M.D., with the help of 84 contributors. Vol. ii, for the years 1917–1918. Large 4to. Pp. 471, with 175 illustrations. 1921. New York: Surgery Publishing Co. $10.

THE American Year-Book of Anæsthesia and Analgesia published in January, 1921, is a comprehensive collection of instructive papers describing researches undertaken and advances made during 1917 and 1918. The Editor has given prominence to subjects of clinical importance, and has placed side by side articles by authors holding opposite views, thus supplying the reader with

evidence from which to form his own opinion in matters of a controversial nature. In some instances, however, the contradictory statements contained in papers by different authors fail to be of value owing to lack of data. For example, Mytinger states that in anæsthetizing epileptics, convulsive seizures are almost constantly to be dealt with; on the other hand Collier, with a large experience, finds it exceptional to see a convulsive attack. If Mytinger had given details of the methods of anæsthesia employed by him, some useful deductions might have been obvious.

In the section on complicating factors of anæsthesia are two contributions on heart lesions by Willius and Richardson respectively. Willius is of opinion that "the general tendency is to require too great a margin of cardiac safety in surgical work"; he has taken as his material such lesions as mitral stenosis, aortic disease, auricular fibrillation, and auricular flutter; it would have enhanced the value of his work if his material had included also such lesions as fatty degeneration, septic myocarditis, and pericarditis.

Richardson deprecates the use of scopolamine in patients with cardiac lesions, and repeats the warning note as to the delusion that gas and oxygen is the safest of all general anæsthetics—he holds the opinion that this anæsthetic is far from safe in cases of broken compensation and angina pectoris. With reference to the use of ether and chloroform in these cases, Richardson lays stress on the importance of "mixing the drugs on the mask as indicated and not according to any preconceived formula".

The history of open ether, from its introduction in 1893 by Dr. Prince up to the present time, is well described by Dr. Herb, who makes several points in favour of this, as compared with other methods of ether administration, and gives strong reasons for concluding that the conservation of body heat is "of much greater importance than is the warming of the ether vapour". This question of the value or otherwise of warming ether vapour is discussed from different points of view by Shipway and Pembrey on the one hand, and McCarty and Davis on the other.

Mann, of Rochester, has contributed two valuable papers on the effects of etherization upon the blood and upon the vascular reflexes, in which he shows that with surgical degrees of etherization phagocytosis is increased and not decreased; also that with ether tension high enough to abolish the corneal reflex, the blood-pressure falls, and that there is less tendency to a fall with lower degrees of ether tension such as produce so-called "light anæsthesia". The work of Muns on shock has also a bearing on this problem of what is the best degree of etherization for the purpose of preventing shock; the author maintains that shock is produced by surgical stimuli and by ether stimuli, and that these two factors ought "to be properly balanced".

Embley's remarks concerning the physio-pathology of ethyl chloride will be of interest to many anæsthetists who wonder why this drug is not more popular. The salient points elicited by this piece of research are that ethyl chloride causes lowered blood-pressure through a weakened action of the heart, and that vagus danger is due to concentration of the anæsthetic, which can be regarded as comparatively safe only when care is taken that the corneal reflex is not abolished.

The experiences of anæsthetists in war surgery are interestingly written by Howell, Marshall, Corfield, and Vignes abroad, and McCardie, Silk, Boyle, and Clarke at home.

The section on local anæsthesia is well illustrated and contains good detailed accounts of the technique necessary for successful analgesia in various operations, including appendicectomy, laminectomy, Cæsarean section, thyroidectomy, and others.

The index of current literature of anæsthesia will be helpful to students investigating any particular branch of this subject; the book as a whole is extremely interesting, and abounds in useful information.

Indispensable Orthopædics. By F. CALOT, Surgeon-in-Chief to the Orthopædic Institute at Berck. Second English edition, translated from the seventh French edition by A. H. ROBINSON, M.D., M.R.C.S. Large 8vo. Pp. xii + 1108, with 1140 figures and 8 coloured plates. 1921. London: Ballière, Tindall & Cox. 42s. net.

THIS important book undoubtedly represents the fullest and most authoritative work on the subject of conservative surgical treatment of bone and joint tuberculosis, and it also gives a good account of the orthopædic affections.

The importance of the treatment of bone and joint tuberculosis by immobilization, open air, and heliotherapy was never greater than to-day, because whilst most medical practitioners and surgeons are convinced that operative measures should play only a minor part in this matter, they are by no means familiar with the necessities of the conservative methods.

The author in his preface and in the text writes as though his object was to instruct the general practitioner how to undertake the treatment of these cases himself. We feel quite sure that this is entirely wrong. Let any medical man visit the institute at Berck Plage or at Alton and then ask himself, "Am I justified in keeping early cases of hip or spinal disease under my own care when I might send them to an institute?" It is the greatest mistake to think that conservative treatment is easier than operative. It may be true that the puncture and aspiration of an abscess is an easy thing, but the efficient mechanical and hygienic treatment of the case requires judgement, patience, and the resources of a special institute.

The opening chapters of the book dealing with methods and apparatus are invaluable for their wealth and clearness of detail. The book does not deal with any complicated operative procedures

such as bone grafting or open operations for congenital dislocation of the hip, and in this respect is an incomplete presentation of modern orthopædic surgery. But it represents the outcome of long and patient work with a vast number of patients, and it thus forms the most authoritative exposition of conservative orthopædics.

The present edition has relegated Abbott's treatment of scoliosis to a very minor place; the subjects of adult coxa vara and the surgical treatment of infantile paralysis are dealt with at greater length.

The illustrations are clear and profuse, and the English text is beyond criticism.

Urologische Operationslehre (Essays on the Operative Surgery of the Urinary Organs). Edited by Professor Dr. Voelcker and the late Professor Dr. Wossidlo. Pp. 572, with 445 illustrations, some of which are coloured, and 3 coloured plates. 1921. Leipzig: George Thieme. Unbound, M. 190; bound, M. 225.

This book consists of essays by eleven authors on the operative surgery of the genito-urinary organs; the title 'urologische' is a misnomer, as operations on the testicle, the vas, and the seminal vesicles are included.

The volume is a most attractive one, being well bound, well printed, and most excellently illustrated. The various chapters are not all of the same value, as is almost inevitable in a work of a collective nature; on the whole, however, the level maintained is very high.

The chapters by Prof. Dr. Kümmell, of Hamburg, are particularly well written and of great interest; they deal with the operations on the kidney and its pelvis. As well written, but of even more interest are the articles by Prof. Dr. Voelcker, of Halle, who writes on the operative surgery of the bladder; they contain several original observations and suggestions, and are thoroughly up to date.

The heading of this chapter by Voelcker (Blutige Operationen der Harnblase) is difficult to translate; perhaps 'open operations' is the nearest approach in our language; it seems to us to be an unfortunate term to apply to these operations, as they by no means possess a monopoly in the shedding of blood.

The value of the book is enhanced by the excellent bibliography appended to each section: this is not intended to be exhaustive, but to direct the reader to the best that has been written on the subject. It is curious to observe how often German, American, and even French authors are quoted, and how seldom the British urologist figures in these lists; only five are mentioned, and one of these is disguised under the alias of 'H. Tompson'.

The editing has been most conscientious, and there are very few misprints; we consider that this volume is worth the labour of translation.

The Principles and Practice of Surgery. By Herman A. Havauld, Clinical Professor of Surgery in New York University. 2 vols. Large 8vo. Pp. 2482, with 1044 figures. 1921. New York and London: D. Appleton and Co. £4 4s. net.

This new American text-book of surgery is a carefully written and well proportioned work. It has the advantages and the disadvantages of a one-man book as compared with a system by many authors, but we are inclined to think that in this case the former outweigh the latter.

The first volume deals with wounds, infections, necrosis, injuries, and tumours. The section on bacteriology and the pathology of infective diseases is full and complete, occupying nearly one fifth of the whole work.

The second volume describes deformities, the surgery of the spine, head, neck, face, chest and abdomen.

The latter section, including the surgery of the rectum and genito-urinary system, is compressed into a little more than five hundred pages, which necessitates a very great curtailment of the many subjects treated. Nevertheless we are bound to admit the great skill and judgement on the part of the author in including the essential points of every part of his subject.

The work is an academical summary of surgical principles and practice rather than a practical guide to the student or practitioner. A noteworthy feature is the reference to articles in the literature which ends each chapter; but we think this might have been improved if references to original articles instead of to quotations had been given. For example, one reads with some interest that Buck is to be credited with originating the idea of the extension treatment of fractures; but on turning up the reference we are referred to a quotation by von Volkmann in Pitha-Billroth's handbook.

The illustrations do not compare favourably with those of modern text-books, and we think that there has been a want of judgement in giving many figures of operations such as those of arthroplasty of the hip and knee and resection of the posterior nerve roots, and leaving unillustrated more common operations the results of which are in less dispute.

Nevertheless we think that the book as a whole presents a very fair and well-balanced summary of the science and art of surgery.

General Practice and X Rays: a Handbook for the General Practitioner and Student. By ALICE V. KNOX, M.B., B.Ch. With chapters on Instrumentation by ROBERT KNOX, M.D. Crown 8vo. Pp. 214, with 88 illustrations. 1921. London: A. & C. Black. 15s. net.

UNDER the above heading a most useful little manual has been published by Messrs. A. & C. Black in The Edinburgh Medical Series. It supplies a long-felt need in giving to the general practitioner a good idea of the scope of modern *x* rays.

There has been a prevalent idea that the only useful function of *x*-ray examination lies in the elucidation of fractures, and injuries to bones and joints. This book indicates clearly the many other spheres of usefulness for *x*-ray examination. It is divided into two portions—the first deals fully with the value of *x* rays in diagnosis, and indicates clearly the many directions in which they prove helpful. Another chapter, also very necessary, reviews their position in regard to the treatment of disease. This is good, but very brief.

The second part deals with the instruments necessary to the production of *x* rays. It is clearly and concisely written, and explains to the uninitiated the methods and apparatus used.

Radiology is a science which is advancing by leaps and bounds, and remarks made to-day are almost history to-morrow. This book is of great service because of the clear way it demonstrates what can be done in diagnosis and treatment by modern *x*-ray apparatus.

Diseases of the Ear. By PHILIP D. KERRISON, M.D. Second edition, revised and enlarged. Pp. xxii + 596, with 332 illustrations in text and 2 full pages in colour. 1921. Philadelphia and London: J. B. Lippincott Company. 35s. net.

WE can thoroughly recommend this excellent book. Whether it be the general surgeon who refers to it because he must occasionally tackle an acute mastoid, the young otologist who desires help in the treatment of an acute otitis media, or the more experienced man who looks for guidance in a difficult case of brain abscess, each will find something that he needs in the volume. We believe that the book will take the place that Politzer has so long held on our shelves, with this difference, that it is far more readable than the Austrian book, and in it a single point can much more readily be looked up.

The book is essentially practical, but with this the scientific work done on the ear is well blended; above all, the author is clearly a man of principle who has his patient's welfare first before him. It is not to be expected that anyone will agree with everything that is said in a volume of this size. When he wants an independent view the author is able to take it, and is prepared to break with tradition if he think the evidence demands it. It is hard in such a work to pick out one chapter above the others. We have found that on labyrinthine disease particularly useful, the clinical varieties of labyrinthitis are well differentiated, and the tests, and the physiology of the vestibule are set out as clearly perhaps as is possible. The chapter shows us how very little we knew of the subject, and how conjectural is much that we believe we do know.

We wish this book every success on both sides of the Atlantic, and shall be pleased to welcome its author in the event of his crossing over to ours.

Clinical Surgery by Case Histories. By ARTHUR E. HERTZLER, M.D., Ph.D., F.A.C.S., Professor of Surgery in the University of Kansas. In 2 vols. Pp. 1083, with 483 illustrations. 1921. London: Henry Kimpton. £5 net.

THESE volumes deal with the whole range of clinical surgery from a novel point of view, that of case histories; in fact, the volumes are made up almost entirely of case histories arranged topographically.

The practical side of surgery is kept to the fore, emphasis being laid on diagnosis and indications for treatment. The books are profusely illustrated by nearly five hundred photographs, including skiagrams and micro-photographs: these the author rightly considers a very valuable feature of the work.

The first twenty-eight pages are devoted to general principles, and bristle with poignant remarks, which all surgeons may well read. For instance: "The surgeon must have a 'change of pace' as the baseball pitchers say". "Once the surgeon has diagnosed the disease he must diagnose the patient". "Some operate rapidly, one might say uproariously".

Case histories then follow, each being detailed under the headings of history, examination, diagnosis, treatment, pathology, after-course, and comment.

The cases have all been under observation at the Halstead Hospital, and each has been selected on account of some outstanding point of interest; as the writer says, they represent sober after-thought, rather than "achievement on parade". Pathology has been presented with the greatest possible brevity, this obviously being the best plan in a book which is essentially clinical.

We can strongly recommend the reading of this work. It has an attractive freshness, and a freedom from convention and tradition; it is brimful of common sense, and gives one an opportunity of reviewing clinical cases from a new and practical standpoint.

On Bone Formation: its Relation to Tension and Pressure. By Dr. Murk Jansen, O.B.E., Lecturer on Orthopædic Surgery, University of Leiden. Large 8vo. Pp. 114, 54 figures. 1920. London: Longmans, Green & Co. 20s. net.

It is refreshing to read a surgical book of to-day which is frankly non-utilitarian in its aim and scope. After a short review of the literature dealing with the subject of pressure and tension in their relation to bone formation, the author discusses the problem of the internal architecture of various normal and morbid bones. His main thesis is that tension forces have no part in the determination of the structure of bones, but that pressure force is the sole and dominating factor. These problems are discussed in relation to the upper end of the femur, the calcaneum, the ankylosed knee, the mandible, and cranial bones. After a detailed consideration of the conditions of origin of cancellous tissue, the final chapters deal with bone formation, the form of bones, and the purposive factors in bone formation.

Perhaps the most suggestive parts of the book are those which deal with the reaction of bone tissue to pressure and the conditions in which this will lead either to growth or absorption.

Considering the highly abstruse nature of the subject, the author may be congratulated on the clearness of language in which it is expressed. The photographs of macerated bones in section form one of the most valuable features of the work.

Injuries and Diseases of the Bones and Joints: their Differential Diagnosis by means of the Roentgen Rays. By F. H. Baetjer, M.D., and C. A. Waters, M.D. Royal 8vo. Pp. 349, with 333 illustrations. 1921. London: H. K. Lewis & Co. Ltd. £3 10s. net.

This most valuable and up-to-date work consists of a veritable atlas of the skiagrams of normal, injured, and diseased bones and joints. Accompanying the pictures is a clearly-written account of these conditions, principally with a view to aiding diagnosis. No doubt in future editions the value of the work will be increased by the inclusion of a greater number of pictures of different varieties of the complicated types of fracture, such as those of the pelvis.

The results of special forms of treatment, such as bone grafting, are only dealt with very briefly, and this too, we think might be enlarged with advantage.

A remarkably complete and typical collection of different forms of bone tumour is presented, and there are several figures illustrating hæmophilia.

The section on tuberculous disease of the spine is poorly illustrated, and we should have thought the importance of this part of the subject would have deserved much fuller treatment.

Chirurgie de Guerre et d'après-Guerre. By Auguste Broca. Royal 8vo. Pp. 479, with 545 figures. 1921. Paris: Masson & Co. 25 fr.

Many British surgeons will be familiar with the two War Medical Manuals which this writer published dealing with the immediate and late effects of wounds of the bones and joints. This volume appears to be in the main an amplification of those two small books, and deals almost entirely with similar subjects. The first chapters deal with the general organization of the hospitals in which the author worked, and with statistics; those that mention the former are not full enough to instruct anyone unfamiliar with the general outline of the French Medical Service, and to those who are they would be superfluous; the statistics are founded on less than 3000 cases, and are of course liable to the usual errors if an attempt is made to follow out any deduction from them.

The general principles of wound treatment, removal of foreign bodies, etc., seem to be those which were approved by British surgeons; we get no chapter on recent abdominal wounds, for the author had no experience of such. He does not suggest that he obtained any definite opinion as to the value of exploration with a needle in vague chest conditions, or as to the necessity of evacuating collections of blood in the pleura—questions which we know were being hotly debated in French surgical societies at the very time these cases were being treated.

The chapters on the late treatment of wounds of joints and bones are those which justify the publication of the volume; much of their interest centres round the question of esquillectomy, and Broca argues in favour of a moderate, delayed operation, much, we believe, as most British surgeons would, and makes a good case for his view that this is really what Ollier held, even though his followers have argued that he favoured esquillectomy, primary and 'large'.

It is an obviously honest candid picture of a personal but limited experience; is it unfair to admit to being disappointed in deriving from its perusal no more defined and clear-cut views? If so, the blame must be given to the author's earlier writings, from which we were led to anticipate a much clearer surgical vision than this volume displays.